SOCKEYE SALMON SMOLT INVESTIGATIONS ON THE CHIGNIK RIVER WATERSHED, 2002

By

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COMMERCIAL VENDOR NAMES

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ABSTRACT

This paper provides the results from the ninth year of the Chignik River sockeye salmon smolt enumeration project. Juvenile sockeye salmon *Oncorhynchus nerka* were captured in a rotary screw trap array and sockeye salmon smolt abundance was estimated using mark-recapture techniques. Sockeye salmon smolt were measured throughout the emigration for age, length, and weight data. In 2002, 16,717,551 sockeye salmon smolt were estimated to pass downstream of the traps from May 1 to July 8. Of these, 440,947 (2.6%) were age 0., 13,980,423 (83.6%) were age 1., 2,223,966 (13.3%) were age 2., and 72,184 (0.4%) were age 3. smolt. Smolt abundance data, by emigration year, were paired with 3-ocean returns from that emigration year to forecast the 2003 sockeye salmon run. Based on smolt data and historic age composition estimates, it was estimated that approximately 1.82 million sockeye salmon are expected to return in 2003. The 2004 run is expected to be about 3.08 million sockeye salmon and the 2005 run is expected to be about 2.12 million sockeye salmon. Because only five years' smolt and corresponding adult return data were used to produce this forecast, the confidence in this particular forecast is fair, but this technique shows promise if current statistical trends continue.

INTRODUCTION

Economically, sockeye salmon *Oncorhynchus nerka* is the most important commercial salmon species in the Chignik Management Area (CMA). The Chignik River watershed is the primary sockeye salmon producer in the CMA, and consists of a large, shallow lagoon, two large lakes (Chignik and Black Lakes), and several tributaries that provide both spawning and rearing habitat for juvenile sockeye salmon (Figure 1). The Chignik River watershed is also the largest sockeye salmon producing watershed on the south side of the Alaska Peninsula (Pappas et al. 2001). Two distinct runs of sockeye salmon exist in the Chignik River watershed. The early run, with an escapement goal of 350,000 to 400,000 sockeye salmon, spawn in Black Lake and its tributaries and primarily enters the watershed from June through mid-July. The late run, with an escapement goal of 200,000 to 250,000 sockeye salmon (through August 31), typically spawns in the tributaries and on the shoals of Chignik Lake. Sockeye salmon that spawn in Black Lake are genetically distinct from sockeye salmon that spawn in Chignik Lake (Templin et al. 1999). The interactions between the Black Lake (early run) and Chignik Lake (late run) stocks are poorly understood. Specifically, Chignik Lake's role as a nursery area for the Black Lake stock is believed to be increasing with the natural sedimentation of Black Lake (Bumgarner 1993).

Juvenile salmon are known to attain the smolt stage after certain size thresholds are met, during specific seasons, and under the influence of photoperiod and temperature (Clarke and Hirano 1995). Smolt migration is triggered by increasing springtime water temperatures (3-4 ^{o}C), and increasing day length (Clarke and Hirano 1995). Variables affecting growth in juvenile salmonids include temperature, competition, food availability, and various water chemistry parameters (Moyle and Cech 1988). Annual growth of juvenile sockeye salmon often varies between lakes, years, and within individual populations (Bumgarner 1993). This variability in growth is due to fluctuations in one or more of the previously mentioned variables. Typically, if growth rates are not sufficient to achieve the threshold size necessary to emigrate in the spring, the juvenile fish will remain in the lake feeding for another year (Burgner 1991), possibly further increasing competition among younger broods. These interactions can be investigated via smolt emigration data.

Typically, sockeye salmon smolts migrate quickly to saltwater from their nursery lakes and spend only enough time in the river to travel to the marine environment (Burgner 1991). However, not all juvenile sockeye salmon emigrating from Chignik and Black lakes have gone directly to sea. It has been speculated that a component of the rearing juveniles may have remained in the Chignik River in the summer to feed and subsequently returned to Chignik Lake in the fall (Roos 1957, 1959; Iverson 1966). Small young-of-the-year sockeye salmon have been captured in large numbers in the Chignik River and Chignik Lagoon during the summer months (Bouwens and Edwards 2001; Finkle and Bouwens 2001; Bouwens and Finkle *in press*). Further studies are being conducted to investigate to what extent juvenile sockeye salmon use the river and the lagoon as a rearing area (Finkle and Bouwens 2002).

The 2002 field season completes the ninth season that the Alaska Department of Fish and Game (ADF&G) has operated a smolt project on the Chignik River funded by the Chignik Regional Aquaculture Association (Bouwens and Edwards 2001; Edwards and Bouwens 2002; Bouwens et al. 2000; Kaplan and Swanton 1997, 1998; Perez-Fuentetaja et al. 1999, Stopha and Barrett 1994; Vania and Swanton 1996). These data have been combined into a baseline database that is being used to generate a smolt-based sockeye salmon forecast to the Chignik River watershed. Forecasts enable fish processors to estimate the amount of supplies and personnel needed to process a given expected harvest and forecasts help commercial fishers estimate personnel and equipment needs. Historic preseason forecast methods used for predicting adult runs to the Chignik River watershed currently employ historic age class relationships for the early run and return per spawner relationships for the late-run stocks (Witteveen et al. *in press*). Smolt emigration estimates by age, and potentially stock, are expected to add to the forecast models currently used.

OBJECTIVES

The objectives for the 2002 season were:

(1) Estimate the total number of emigrating sockeye salmon smolts, by age, from the Chignik River watershed;

(2) Describe sockeye salmon smolt emigration timing and growth characteristics (length, weight, and condition factor) by age for the Chignik River watershed;

(3) Continue to build a smolt database in an effort to estimate smolt-to-adult survival and forecast future runs, and;

(4) Summarize the 2002 smolt emigration data in a report.

METHODS

Study Site and Trap Description

Two rotary-screw traps were operated side by side to capture smolts emigrating from Chignik Lake. The trapping site was located 8.6 km upstream from Chignik Lagoon (Mensis Point) and 1.9 km downstream from the outlet of Chignik Lake (56° 15’ 26” N lat., 158° 43’ 49” W long.; Figure 2). The traps were located near a bend in the river and were positioned in that portion of the river with the highest current. Due to safety concerns about using steel cables in an area with high boat traffic, each trap was secured to the riparian vegetation with highly visible polypropylene line and a strobe light was attached to the top of the offshore trap.

Each trap consisted of a cone constructed of aluminum perforated plate (5 mm holes) mounted on two aluminum pontoons, with the large ends of the cones pointed upstream. The cone mouth diameter was 1.5 m on the small trap (placed nearshore), and 2.4 m on the large trap (placed offshore). The small trap sampled approximately 0.73 m^2 and the large trap sampled approximately 2.02 m^2 of the river’s profile. The current propelled an internal screw, which rotated the cone at approximately 3-9 revolutions per minute (RPM) during average water flow conditions, but ran up to 13 rpm during peak flow conditions. Fish were funneled through the cone into an approximately 0.7 m^3 rectangular live-box on the downstream end of each trap. A pair of adjustable aluminum support legs were utilized to maintain and adjust the traps' positions from the shore and their orientation in the current.

During the 2002 field season, both of the traps were operated continuously from 1205 hours on May 1 to 1200 hours, July 9, except when the cones were elevated to facilitate daily cleaning (<30 minutes per day). At the completion of the project, both the traps were disassembled and stored.

A floating platform for a 10'x12' weatherport was tied directly behind the traps and connected to the traps with a boardwalk. The weatherport provided shelter for the crew when processing samples taken from the traps.

Smolt Enumeration

Sampling days extended from noon to noon and were identified by the date of the first noon-to-midnight period. The traps were checked hourly between 2400 hours and 0530 hours on the weekdays and from 2400 hours to 0400 hours on the weekends. The traps were also checked at the end of the smolt day at 1200 hours and again at 1800 hours.

Juvenile sockeye salmon greater than 45 mm fork length (FL; mid-eye-to-fork-of-tail) were considered smolts (Thedinga et al. 1994). All sockeye salmon smolts caught in the traps were counted. Fish were netted out of the traps' holding boxes, identified (McConnell and Snyder 1972; Pollard et al. 1997), and individually counted. Sockeye salmon smolts recaptured during mark-recapture experiments were recorded separately from unmarked smolts and excluded from daily total catch to prevent double counting. Sockeye salmon fry (< 45 mm FL), coho salmon *O. kisutch* juveniles, pink salmon fry *O. gorbuscha*, chinook salmon *O. tshawytscha* juveniles, Dolly Varden *Salvelinus malma*, stickleback of the family Gasterosteidae, pond smelt *Hypomesus olidus*, Pygmy whitefish *Prosopium coulteri*, starry flounder *Platichthys stellatus*, coastrange sculpin *Cottus aleutus*, and eulachon *Thaleichthys pacificus* were also counted. The isopod *Mesidotea entomon* was also identified according to Merrit and Cummings (1984) and Pennak (1989) and counted.

Age, Weight, and Length Sampling

A daily sample of 40 sockeye salmon smolts was collected for five days per statistical week for age-weight-length (AWL) data. All smolt sampling data reflected the smolt day in which the fish were captured, and samples were not mixed between days. A sample of smolts was collected hourly throughout the night's migration and held in an in-stream live box. The number of fish sampled hourly was proportional to the migration strength. Forty smolts were then randomly collected from the live box and sampled for AWL data, and the remaining smolts were released downstream from the traps.

Tricaine methanesulfonate (MS-222) was used to anesthetize smolts prior to sampling. Fork length (FL) was measured to the nearest 1 mm, and weighed to the nearest 0.1 g. Scales were removed from the preferred area (INPFC 1963) and mounted on a microscope slide for age determination. After sampling, fish were held in aerated water until they recovered from the anesthetic, and subsequently were released downstream from the traps. Age was estimated from scales using a microfiche reader (EYECOM 3000) under 60X magnification. All data were recorded in European notation (Koo 1962).

Condition factor (Bagenal and Tesch 1978), which is a quantitative measure of the "fatness" of a fish, was determined for each smolt sampled using:

$$K = \frac{W}{L^3} 10^5 , \tag{1}$$

where K is smolt condition factor, W is weight in g, and L is FL in mm.

Trap Efficiency Estimates

Mark-recapture experiments were conducted weekly when sufficient smolts were available to determine trap efficiency. For each experiment, a goal of 3,000 sockeye salmon smolts (minimum of 1,000) were collected from the traps and transferred to a series of instream flow-through live boxes. Smolts were retained in the live boxes for up to two nights if insufficient numbers were captured the first night. After two nights all captured smolts were marked if the minimum sample size was met or released if the minimum was not met.

Sockeye salmon smolts were netted from the live boxes, counted, and marked in a repository containing an aerated Bismark Brown dye solution (3.9 g of dye to 75.5 L of water) for 15 minutes. Fresh water was then pumped into the container to slowly flush out the dye (45 min), after which the smolts were allowed to recover in the circulating water. At the end of the marking process, dead and stressed smolts were removed, counted, and disposed of below the mouth of the traps.

The remaining marked smolts were taken to the release point. Smolts were transported upstream in aerated buckets and released evenly across the breadth of the river. All releases occurred 1.3 km upriver from the traps (Figure 2). The marking was performed so that the marked fish were released by 2400 hours.

Mark retention and delayed mortality experiments were conducted in conjunction with each mark-recapture test using a random sub-sample of approximately 200 sockeye salmon smolts. Before marking fish, about 100 sockeye salmon smolts were removed from the transport tote and placed in an in-stream live box. These fish were handled the same as the fish that were marked, except they were not placed in the dye solution. After the marking and recovery period, approximately 100 additional marked smolts were placed in another in-stream live box. These smolts were examined each day during the mark-recapture test for mortalities and the number of mortalities from each group was recorded. These smolts were released downstream of the traps at the beginning of each new mark-recapture test or after five days, whichever came first. The Chignik River watershed smolt population was estimated by using methods described in Carlson et al. (1998).

Marine Survival Estimates and Future Run Forecasting

Estimates of smolt abundance, by age, were paired with corresponding adult returns from their respective brood year (BY). By regulation, the total return to the Chignik River watershed is calculated by adding the total Chignik River sockeye escapement to the total catch from the CMA plus a portion of the sockeye salmon catch from the Southeastern District Mainland of the Alaska Peninsula Management Area and the Cape Igvak Section of the Kodiak Management Area [5 AAC 09.360(g); 5AAC 18.360(d)]. Marine survival, by age, and the number of smolts produced per spawner from their respective BY was also calculated.

It was clear from an impossible marine survival estimate of emigration year 1996 that the smolt abundance was underestimated in this year. Therefore, data from 1996 were not included in regression analyses for predicting future adult returns. Regression relationships were explored between smolt abundance estimates and corresponding adult returns, by emigration year, to investigate the potential of using smolt emigration estimates to forecast future adult sockeye salmon runs. Standard regression diagnostic techniques were used. Regressions were developed between individual freshwater age classes and their corresponding adult returns (by freshwater age) and between total smolt emigration estimates and corresponding adult returns (by ocean age).

Statistically significant relationships were used to forecast the 3-ocean components (historically approximately 80% of the entire run) of the 2003, 2004, and 2005 adult sockeye salmon runs from the 2000, 2001, and 2002 smolt emigration data.

Climate and Hydrology

Trap revolutions (rpm), water depth (cm), and daily climate observations, including air and water temperature (°C), estimated cloud cover (%), and estimated wind velocity (mph) and direction were recorded daily at 1200 hours and again at the first trap-checking occasion each night.

RESULTS

Trapping Effort

Both the large and the small traps were in place for a total of 69 days beginning on May 1 and ending on July 9. The traps fished continuously for the duration of the study, except when they were removed for daily cleaning.

Trap Catch

A total of 137,884 sockeye salmon smolts were captured in the traps in 2002 (Appendix A). In addition to sockeye salmon smolts, a total of 33,202 sockeye salmon fry 1,623 juvenile coho salmon, 1,174 pink salmon fry, 1,053 Dolly Varden char, 6,200 stickleback, 337 juvenile chinook salmon, 247 pond smelt, 24 pygmy whitefish, 52 starry flounders, 1,104 sculpin, 174 isopods, and 4 Alaska blackfish were captured (Appendix A). The larger, offshore trap was responsible for 81.4% of the sockeye salmon smolts captured in 2002 (Appendix B).

Age, Weight, and Length Sampling

A total of 2,038 sockeye salmon smolts were sampled for AWL data in 2002. Age 0. smolts from BY 2001 comprised 10.6% of the sample, 77.9% were age 1. (BY 00), 11.1% were age 2. (BY 99), and 0.3% were age 3. (BY 98; Table 1). The mean length and weight of age 0. smolts were 48.9 mm and 1.2 g. The mean length and weight of age 1. smolts were 64.9 mm and 2.3 g. The mean length and weight of age 2. smolts were 80.1 mm and 4.9 g. The mean length and weight of age 3. smolts were 110.0 mm and 13.8 g (Table 2). The mean length of the age 1. sockeye salmon that emigrated in 2002 was similar to that of 2001, which was shorter than the three prior years. These fish were, on average, slightly heavier than the 2001 fish (Table 3; Figure 3). The age 2. smolt, however, were the third longest and the heaviest measured since the beginning of the project (Table 3; Figure 3), although these age 2. sockeye salmon were proportionately the least abundant (Table 4). Lengths of ages 0., 1., and 2., smolts were plotted in a length frequency histogram to investigate the possibility of using length frequency data to serve as an indicator of stock-of-origin (Figure 4); age 3. smolts were not included due to the small sample size of this age class.

Trap Efficiency Estimates

Mark-recapture experiments were conducted on nine occasions beginning on May 3 and ending on June 29. Trap efficiency estimates ranged from a low of 0.25% to a high of 2.43% (Table 5). The majority of the marked smolts were recaptured within two days of being released (Appendix A). Mark loss data was collected but not included in the calculation of trap efficiency during the 2002 trapping season (Table 6).

Sockeye Salmon Smolt Emigration and Timing

The estimated number of sockeye salmon smolts that emigrated in 2002 was 16,717,551 (±4,139,358; 95% C.I.; Table 7; Figures 5 and 6). The 2002 emigration consisted of 44,947 age 0., 13,980,423 age 1., 2,223,996 age 2., and 72,184 age 3. sockeye salmon smolts (Tables 7 and 8; Figure 7). The majority of the smolts emigrated in 2002 during late May and early June (Figures 6 and 8). The age 1., and 2., smolts tended to emigrate together while the age 0. smolts emigrated later in the trapping season (Figure 8). The number of smolts produced in 2002 was similar in magnitude to the 2000 emigration (Table 7; Figure 5).

Marine Survival Estimates and Future Run Forecasting

All adult sockeye salmon from BYs 1992, 1993, 1994, and for the most part, 1995, have returned to the Chignik River, and the overall marine survival of smolts ranged from 11% for BY 1995 to 66% for BY 1993 (Table 9). When the data were presented by emigration year, however, the marine survivals ranged from 8% for emigration year 1999 to 195% for emigration year 1996, with 1996 being an obvious outlier (Tables 10 and 11).

A significant regression relationship (*P*=0.031; R^2=0.83) was found between the total smolt emigration estimates, by year, and their subsequent 3-ocean returns (Figure 9). A marginally significant (*P*=0.10; R^2=0.63) relationship was found between the total smolt emigration estimates and the entire resulting adult return. All other relationships examined (age 0. smolts vs. age 0. adults, age 1. smolts vs. age 1. adults, age 2. smolts vs. age 2. adults, age 3. smolts vs. age 3. adults, total smolts vs. 1-ocean adults, total smolts vs. 2-ocean adults, total smolts vs. 3-ocean adults) were not significant.

Using total number of emigrating smolts, by year, to predict subsequent 3-ocean returns, the 3-ocean component of the 2003 adult run is estimated at 1.46 million sockeye salmon. In addition, it was possible to estimate the 3-ocean 2004 adult run at 2.46 million, and the 3-ocean 2005 adult run at 1.70 million sockeye salmon. Based on smolt data alone and assuming that the 3-ocean component of the run will remain at 80% of the entire sockeye salmon run in future years, the 2003 total adult run forecast is 1.82 million sockeye salmon, the 2004 adult run forecast is about 3.08 million sockeye salmon, and the 2005 adult run forecast is about 2.12 million sockeye salmon.

Physical Data

The absolute depth of the river varied during the course of the season from 97 cm to 171 cm. Daily measurements of the depth and velocity (through trap RPM's) of the Chignik River, along with the climatological observations that were collected in 2001, are reported in Appendix C. Water temperatures reached 4^{o}C on about May 8, and the 2002 season was generally characterized by stable water levels and calm winds (Figure 10).

DISCUSSION

A total of 33,202 sockeye salmon fry (pre-smolt) were captured during the 2002 field season, which was substantially less that the number caught in 2001 (Edwards and Bouwens 2002) but still quite substantial compared to other areas. Past data from the Chignik River smolt enumeration project (Bouwens and Edwards 2001; Edwards and Bouwens 2002; Bouwens et al. 2000; Kaplan and Swanton 1997, 1998; Perez-Fuentetaja et al. 1999, Stopha and Barrett 1994; Vania and Swanton 1996) and historical salmon research in the Chignik River watershed (Bouwens and Finkle *in press;* Finkle and Bouwens 2001; Roos 1957, 1959; Iverson 1966) suggest that it is common for large numbers of sockeye salmon fry to emigrate during the smolt emigration season. A large number of fry have been observed throughout the summer months in the Chignik Lagoon and in Chignik River in beach seine catches (Bouwens and Finkle *in press*; Finkle and Bouwens 2001). This demonstrates that sockeye salmon of this size class have taken up residence in the lagoon and river, at least temporarily. Preliminary results of stable isotope analysis suggest that fry enter the lagoon in May and June, but the fry captured in the river in July and August generally do not enter the lagoon that season (Bruce Finney, University of Alaska Fairbanks, personal communication). Sockeye salmon juveniles from some systems show a propensity for early entry into saltwater or estuarine habitats (Phinney 1968; Rice et al. 1994), although high numbers of sockeye salmon fry emigrating during the smolt emigration season are seldom seen in other systems in the Westward Region where smolt enumeration projects have occurred (Steve Honnold, Jim McCullough, Nick Sagalkin, Alaska Department of Fish and Game, Kodiak, personal communications).

The extent that the juvenile sockeye salmon found in the Chignik River and Lagoon survive and grow in the Chignik Lagoon is not well understood. Historically there have not been large numbers of age 0. sockeye salmon in the adult runs at Chignik. It is possible that some sockeye salmon fry are using Chignik Lagoon to rear and grow until they are able to tolerate full strength seawater, and that sometime during this growth period a discontinuity is formed on the scales of these fish that is later interpreted as an annulus. It is also possible that the survival of the age 0. fry is very low, and the fry in the river and lagoon do not contribute significantly to the adult returns. It is also possible that these fry return to Chignik Lake for the winter. Iverson (1966) cited the Chignik River as an important rearing habitat for both the progeny of the river spawners and, more importantly, from fish that spawned in Chignik Lake. He also claimed sockeye salmon fry moved upstream in the Chignik River, suggesting fry in the river may have traveled from the lagoon or lower river to over-winter in Chignik Lake. However, upstream movement of fry has not been documented again since the 1960s.

In 2002, the majority of the smolt emigration took place in late May, well after the traps were in place. Therefore, there were no concerns in 2002 that significant numbers of smolts emigrated prior to the installation of the traps. Increasing daylight starts the metabolic process that allows juvenile sockeye salmon to begin the metabolic process of smoltification (Clarke and Hirano 1995). A certain photoperiod must be reached that corresponds with a certain date each year that does not change annually. Because fish are cold blooded, the smoltification process is also linked to water temperatures, which can add some variability in smolt emigration timing (Clarke and Hirano 1995). Even with the variable emigration timing exhibited between years, it is preferable to have a standardized trapping season, given the set funding structure of this project. The typical starting date of the project, the last week in April, usually coincides with lake ice-out and probably is appropriate. This strategy will avoid the dilemma of missing the smolt emigration by installing the traps either too early and missing the late portion of the emigration or too late and missing the early portion of the emigration.

The length of the smolts that emigrated in 2002 was similar to prior years, but their weight was greater in 2002. The age 2. smolts were almost 2 g heavier, on average, than the age 2. smolts in 2001 (Figure 3). The total abundance of age 2. smolts was low, and proportionately there were fewer age 2. smolts in 2002 than in any other year since the project began in 1994 (Figure 7). Historically, the early run is composed of mostly age 1. sockeye salmon and the late run is composed of age 2. sockeye salmon. The low age 2. smolt abundance in 2002 could indicate that the subsequent late run return (mostly in 2005) will be poor. It also could indicate that the late run will contain more age 1. fish than usual. A third possibility is that due to the metabolic stress of entering marine environment, a mark is formed on the scales of some fish when they enter the lagoon that resembles the mark formed by low growth rates during the winter. Therefore, the scales of late run adults may look like they have spent two winters in freshwater when in fact they have only spent one winter in fresh water. Caution should be used when drawing conclusions from these data, however. The high relative weight of the age 2. smolts in 2002 may facilitate higher-than-average marine survivals of age 2. fish, which may then make up, at least in part, for the lack of abundance of age 2. smolts. The relationship between Chignik smolt size and marine survival has been examined and no relationship has been found; however, the number marine survival estimates (5 usable years) is still small. It should also be reemphasized that there has been no relationship, at least so far, between the age structure of emigrating smolts and the resultant freshwater age structure of returning adult sockeye salmon.

Marked and unmarked smolts were held in conjunction with each mark recapture experiment. The purpose of holding these fish was not necessarily to enable the adjustment of individual mark recapture tests for mark loss. Sample sizes were not large enough and the holding experiment was not designed to enable statistical manipulation of the mark-recapture results. Instead, fish were held to provide qualitative information on the relative success of a mark-recapture experiment. In 2002, especially later in the season, there was some indication that there might have been some differential mortality between marked and unmarked smolts (Table 6). If this was indeed true, then the estimated trap efficiency would have been biased high and the abundance of the emigrating smolts would have been underestimated. Also, marked smolts were held because the dye fades out of marked fish over a period of about a week and marked fish can be somewhat difficult to identify. By examining known marked smolt daily, the crew was provided with a search image to facilitate the identification of marked fish.

Observed marine survivals, by emigration year, of Chignik smolt have ranged from 8 percent to 17 percent (Tables 10 and 11). These figures are well within the ranges observed in other systems (Burgner 1991). This variability in marine survival implies that given constant freshwater production, the resultant adult returns would still fluctuate because of annual differences in the rearing conditions of the marine environment.

The point estimate of the 2002 smolt emigration was lower than the estimated emigration of 2001 but larger than the point estimate in 2000 (Figure 5). Given adult return data, the estimate of 1996 was severely underestimated and not included in the forecast analyses. Further discussion on the removal of the 1996 data can be found in Edwards and Bouwens (2002). In the evaluation of smolt data to predict future runs, the regression relationship that was most statistically significant was 3-ocean returns predicted from the total number of smolts that emigrated three years prior. This is reasonable, since the majority (about 80%) of the Chignik River watershed run consists of 3-ocean sockeye salmon. This forecasting method does not have the resolution to forecast by run, but is adequate to forecast the combined runs. Assuming the 3-ocean component of the run remains at 80%, the 2003 total forecast is approximately 1.82 million sockeye salmon.

A formal forecast is prepared which forecasts specific age classes based on sibling relationships (e.g., age 2.3 abundance in 2003 from age 2.2 abundance in 2002) when possible and median values to forecast the abundance of age classes when sibling relationships do not exist. Using these methods, the 2003 Chignik sockeye salmon forecast is 2.83 million (Witteveen et al. *in press*). The 2003 smolt-based forecast of 1.82 million sockeye salmon is approximately 1.01 million fewer sockeye salmon than was forecasted using sibling regression relationships. Because the smolt forecast is not run specific, it is not possible to break out the estimated harvest from the Cape Igvak and the Southeastern District Mainland fisheries. In 2002, using sibling relationship methods, the forecast of 2.12 million sockeye salmon was 150 thousand fish more than the actual 2002 run of 1.97 million sockeye salmon. A smolt-based forecast was available for the first time in 2002. The 2002 smolt based forecast of 2.28 million sockeye salmon was 310 thousand more than the actual 2002 run. The sibling forecast was more accurate than the smolt forecast in 2002, but the sibling forecast has also been very inaccurate in the recent past. Therefore, until more data is collected to develop the smolt-based forecasting model, the smolt forecast will be provided as a supplemental tool for stakeholders to consider.

In addition to forecasting the 2003 run, it was possible to estimate the 2004 run from the 2001 smolt data and the 2005 run from the 2002 smolt data. As next year's adult return data are added to the data set, assuming the smolt to 3-ocean return relationship remains strong, these forecasts will be updated and they may change. Nonetheless, assuming the same 80% 3-ocean contribution, the 2004 run (based on smolt data alone) is expected to be about 3.08 million sockeye salmon and the 2005 run is expected to be about 2.12 million sockeye salmon.

Because of the small data set our confidence in the smolt-based forecast is only fair. If the current trends continue, however, forecasts incorporating smolt data may be more accurate than the forecasting methods using sibling relationships alone. Specifically, the variability in freshwater rearing success is removed from forecasts as smolt abundance is measured after the freshwater rearing period. Further, sibling regression relationships are marginal or non-significant for a number of age classes that compose a large portion of the Chignik runs. These age classes are forecasted based on the median returns of that age class. Currently, the smolt based forecast is limited in that it is not possible to forecast the magnitude of the separate runs.

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Table 1. Estimated age composition of Chignik Lake sockeye salmon smolts by week, 2002.

Stat Week	Sample Size		Ages 0	1	2	3	Total
18	80	Percent	0	96.2	3.8	0.0	100.0
		Numbers	0	77	3	0	80
19	279	Percent	0.0	88.9	11.1	0.0	100.0
		Numbers	0	248	31	0	279
20	200	Percent	0.0	89.5	10.5	0.0	100.0
		Numbers	0	179	21	0	200
21	200	Percent	0.0	84.5	15.5	0.0	100.0
		Numbers	0	169	31	0	200
22	200	Percent	0.0	88.9	11.1	0.0	100.0
		Numbers	0	171	28	1	200
23	200	Percent	0.5	84.0	15.0	0.5	100.0
		Numbers	1	168	30	1	200
24	200	Percent	8.5	78.0	12.0	1.5	100.0
		Numbers	17	156	24	3	200
25	199	Percent	0	88.90	11.10	0.00	100.0
		Numbers	62	107	30	0	199
26	200	Percent	25.5	61.5	12.5	0.5	100.0
		Numbers	51	123	25	1	200
27	200	Percent	24.0	74.0	2.0	0.0	100.0
		Numbers	48	148	4	0	200
28	80	Percent	47.5	52.5	0.0	0.0	100.0
		Numbers	38	42	0	0	80
Total	2,038	Percent	10.6	77.9	11.1	0.3	100.0
		Numbers	217	1,588	227	6	2,038

Table 2. Length, weight, and condition factor of Chignik River sockeye salmon smolts, by age and statistical week, 2002.

				Length (mm)		Weight (g)		Condition Factor	
Age	Stat Week	Starting Date	Sample Size	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
0	23	5/31	1	50	na	1.2	na	0.96	na
0	24	6/7	17	47.8	0.54	1.2	0.06	1.05	0.036
0	25	6/14	62	47.3	0.36	1.1	0.03	1.01	0.025
0	26	6/21	51	48.9	0.63	1	0.05	0.89	0.022
0	27	6/28	48	49.9	0.6	1.2	0.05	0.97	0.022
0	28	7/5	38	50.7	0.71	1.4	0.06	1.05	0.022
Total			217	48.9	0.27	1.2	0.02	0.98	0.012
1	18	4/26	77	66	0.57	2.3	0.06	0.79	0.011
1	19	5/3	248	67.5	0.3	2.3	0.03	0.73	0.006
1	20	5/10	179	67.4	0.34	2.3	0.04	0.76	0.005
1	21	5/17	169	69	0.39	2.6	0.05	0.79	0.006
1	22	5/24	171	68.6	0.29	2.6	0.03	0.80	0.005
1	23	5/31	168	65.5	0.35	2.4	0.04	0.84	0.006
1	24	6/7	156	66.6	0.38	2.7	0.05	0.90	0.009
1	25	6/14	107	64.6	0.66	2.6	0.08	0.94	0.015
1	26	6/21	123	58.4	0.69	1.9	0.07	0.90	0.011
1	27	6/28	148	54	0.42	1.4	0.03	0.89	0.011
1	28	7/5	42	55.8	1.05	1.8	0.11	1.00	0.019
Total			1,588	64.9	0.18	2.3	0.02	0.83	0.003
2	18	4/26	3	80.3	6.57	4.9	1.43	0.89	0.037
2	19	5/3	31	79.1	1.24	3.8	0.22	0.74	0.015
2	20	5/10	21	80.5	1.20	4.3	0.21	0.82	0.017
2	21	5/17	31	79.7	1.63	4.5	0.38	0.85	0.016
2	22	5/24	28	74.9	1.43	3.7	0.33	0.83	0.015
2	23	5/31	30	82.8	2.93	5.9	0.66	0.92	0.027
2	24	6/7	22	87.7	3.34	7.3	0.70	0.97	0.024
2	25	6/14	30	83.2	2.37	6.1	0.48	0.99	0.017
2	26	6/21	25	76.7	2.20	4.6	0.53	0.94	0.014
2	27	6/28	4	62.7	2.02	2.3	0.30	0.90	0.053
Total			225	80.1	0.78	4.9	0.18	0.88	0.008
3	22	5/24	1	143.0	0	26.7	0.00	0.91	0.000
3	23	5/31	1	115.0	0	14.0	0.00	0.92	0.000
3	24	6/7	3	100.0	4	10.5	1.03	1.04	0.019
3	26	6/21	1	102.0	0	11.0	0.00	1.04	0.000
Total			6	110.0	7.24	13.8	2.67	1.00	0.027

Table 3. Mean length, weight, and condition factor of sockeye salmon smolts sampled from the Chignik River, by year and age, 1994 to 2002.

		Length (mm)			Weight (g)			Condition Factor		
Year	Age	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error	Sample Size	Mean	Standard Error
1995	0	272	46.4	0.18	272	0.7	0.01	272	0.74	0.007
1996	0	125	48.7	0.45	113	1.0	0.03	113	0.82	0.014
1997	0	195	46.4	0.22	195	0.8	0.01	195	0.83	0.008
1998	0	15	44.8	0.96	15	0.7	0.03	15	0.73	0.031
1999	0	40	51.8	0.79	40	1.3	0.06	40	0.97	0.032
2000	0	223	60.3	0.52	223	2.1	0.05	223	0.91	0.008
2001	0	96	55.7	0.51	96	1.5	0.04	96	0.88	0.014
2002	0	217	48.9	0.27	217	1.2	0.02	217	0.98	0.012
1994	1	1,715	66.6	0.16	1,706	2.3	0.02	1,706	0.75	0.002
1995	1	1,272	60.2	0.34	1,272	2.0	0.04	1,272	0.82	0.002
1996	1	1,423	67.8	0.29	1,356	2.7	0.04	1,356	0.81	0.004
1997	1	1,673	63.4	0.35	1,673	2.4	0.04	1,673	0.81	0.002
1998	1	785	68.8	0.38	780	2.7	0.06	780	0.78	0.006
1999	1	1,344	77.0	0.17	1,344	4.1	0.03	1,344	0.89	0.003
2000	1	1,175	71.9	0.22	1,175	3.3	0.04	1,175	0.86	0.003
2001	1	1,647	64.5	0.13	1647	2.1	0.02	1,647	0.76	0.003
2002	1	1,588	64.9	0.18	1588	2.3	0.02	1588	0.83	0.003
1994	2	1,091	77.4	0.22	1,068	3.6	0.04	1,068	0.74	0.003
1995	2	1,008	75.1	0.23	1,008	3.5	0.04	1,008	0.80	0.002
1996	2	548	79.9	0.34	533	4.2	0.06	533	0.81	0.004
1997	2	772	83.3	0.25	772	4.7	0.05	772	0.80	0.003
1998	2	1,925	72.4	0.13	1,881	3.0	0.03	1,881	0.76	0.003
1999	2	784	80.8	0.28	784	4.8	0.07	784	0.89	0.003
2000	2	503	76.2	0.34	503	3.6	0.07	503	0.80	0.004
2001	2	389	74.6	0.45	387	3.4	0.09	387	0.77	0.006
2002	2	225	80.1	0.78	225	4.9	0.18	225	0.88	0.008
1996	3	3	100.3	5.55	3	8.4	1.68	3	0.81	0.062
1997	3	12	87.3	1.34	12	5.2	0.35	12	0.77	0.019
1998	3	20	83.6	3.39	19	5.5	0.99	19	0.81	0.018
1999	3	7	90.1	5.76	7	6.8	1.66	7	0.85	0.028
2000	3	14	86.1	2.36	14	5.3	0.63	14	0.79	0.013
2001	3	62	90.4	1.6	61	6.9	0.42	61	0.86	0.011
2002	3	6	110.0	7.24	6	13.8	2.67	6	1.00	0.027
2001	4	1	125.0	NA	1	18.8	NA	1	0.96	NA

Table 4. Estimated age composition of Chignik River sockeye salmon smolt samples, 1991 to 2002.

Year	Dates	Sample Size		Ages 0.	1.	2.	3.	4.	Total
1991	09/08	65	Percent	35.4	64.6	0.0	0.0	0.0	100.0
			Numbers	23	42	0	0	0	65
1994	05/06-06/30	2,806	Percent	0.0	61.1	38.9	0.0	0.0	100.0
			Numbers	0	1,715	1,091	0	0	2,806
1995	05/06-06/29	2,557	Percent	10.7	49.8	39.5	0.0	0.0	100.0
			Numbers	273	1,274	1,010	0	0	2,557
1996	05/06-07/28	2,099	Percent	6.0	67.8	26.1	0.1	0.0	100.0
			Numbers	125	1,423	548	3	0	2,099
1997	05/04-07/22	2,657	Percent	7.3	63.1	29.1	0.5	0.0	100.0
			Numbers	195	1,676	774	12	0	2,657
1998	05/02-07/30	2,745	Percent	0.5	28.6	70.1	0.7	0.0	100.0
			Numbers	15	785	1,925	20	0	2,745
1999	05/10-07/03	2,180	Percent	1.8	61.7	36.1	0.3	0.0	100.0
			Numbers	40	1,345	788	7	0	2,180
2000	04/22-07/20	1,915	Percent	11.6	61.4	26.3	0.7	0.0	100.0
			Numbers	223	1,175	503	14	0	1,915
2001	04/29-07/12	2,195	Percent	4.4	75.0	17.7	2.8	0.0	100.0
			Numbers	96	1,647	389	62	1	2,195
2002	05/01-07/08	2,038	Percent	10.6	77.9	11.1	0.3	0.0	100.0
			Numbers	217	1,588	227	6	0	2,038

Table 5. Results from mark-recapture tests performed on sockeye salmon smolts migrating through the Chignik River, 2002.

Date	No. Released	Total Recoveries	Trap Efficiency[a]
5/3	1,899	12	0.68%
5/9	2,239	27	1.25%
5/16	1,992	4	0.25%
5/23	1,875	9	0.53%
5/29	2,908	16	0.58%
6/5	2,223	53	2.43%
6/13	2,126	45	2.16%
6/19	1,379	30	2.25%
6/29	1,269	17	1.42%
Total	17,910	213	1.19%

[a]Calculated by: = {(R+1)/(M+1)}*100

where: R = number of marked fish recaptured, and;

M = number of marked fish (Carlson et al. 1998).

Table 6. Results of delayed mortality experiments performed on sockeye salmon smolts captured from the Chignik River, 2002.

Date Marked	Days held	Water temp. (°C)	Dye Concenetration	Marked: Number Held	Marked: Mortalities	Unmarked: Number Held	Unmarked: Mortalities
3-May	1	3.5	0.05 g/L	100	5	100	9
	2	3.5			2		9
	3	4.0			10		3
	4	4.5			0		1
				Total Mortalities	17		22
				Percent Mortalities	17.0%		22.0%
9-May	1	3.5	0.05 g/L	91	9	0	
	2	5.0			10		
	3	4.5			1		
	4	5.0			0		
				Total Mortalities	20		
				Percent Mortalities	22.0%		
16-May	1	6.0	0.05 g/L	100	0	100	0
	2	6.0			0		0
	3	6.5			0		0
	4	6.5			0		0
	5	6.0			0		0
				Total Mortalities	0		0
				Percent Mortalities	0.0%		0.0%
23-May	1	6.0	0.05 g/L	50	0	50	0
	2	6.0			7		0
	3	6.0			0		0
	4	6.0			0		0
				Total Mortalities	7		0
				Percent Mortalities	14.0%		0.0%
5-Jun	1	7.0	0.05 g/L	50	6	50	1
	2	8.0			1		0
	3	8.0			0		0
	4	7.0			0		0
				Total Mortalities	7		0
				Percent Mortalities	14.0%		0.0%
13-Jun	1	8.5	0.05 g/L	50	7	50	0
	2	9.0			2		1
	3	9.0			3		0
	4	8.5			2		0
	5	9.0			0		0
				Total Mortalities	14		1
				Percent Mortalities	28.0%		2.0%

Table 7. Chignik River sockeye salmon smolt population estimates, by age class, 1994 to 2002.

		Number of Smolt							95% C.I.	
Year		Age 0.	Age 1.	Age 2.	Age 3.	Age 4.	Total	S.E.	Lower	Upper
1994	Numbers	0	7,263,054	4,270,636	0	0	11,533,690	1,332,321	8,922,341	14,145,038
	Percent	0.0	63.0	37.0	0.0	0.0	100.0			
1995	Numbers	735,916	2,843,222	5,178,450	0	0.0	8,757,588	1,753,022	5,321,664	12,193,512
	Percent	8.4	32.5	59.1	0.0	0.0	100.0			
1996	Numbers	80,245	1,200,793	731,099	5,018	0.0	2,017,155	318,522	1,392,852	2,641,459
	Percent	4.0	59.5	36.2	0.2	0.0	100.0			
1997	Numbers	528,846	11,172,150	13,738,356	122,289	0.0	25,561,641	2,962,497	19,755,145	31,368,136
	Percent	2.1	43.7	53.7	0.5	0.0	100.0			
1998	Numbers	75,560	5,790,587	20,374,245	158,056	0.0	26,398,448	3,834,506	18,882,817	33,914,080
	Percent	0.3	21.9	77.2	0.6	0.0	100.0			
1999	Numbers	73,364	12,705,935	8,221,631	78,798	0.0	21,079,728	3,070,060	15,062,412	27,097,045
	Percent	0.3	60.3	39.0	0.4	0.0	100.0			
2000	Numbers	1,270,101	8,047,526	4,645,121	160,017	0.0	14,122,765	1,924,922	10,349,918	17,895,611
	Percent	9.0	57.0	32.9	1.1	0.0	100.0			
2001	Numbers	521,546	18,940,752	5,024,666	516,723	5,671	25,009,358	5,042,604	15,125,854	34,892,862
	Percent	2.1	75.7	20.1	2.1	0.0	100.0			
2002	Numbers	440,947	13,980,423	2,223,996	72,184	0	16,717,551	2,112,220	12,577,007	20,856,909
	Percent	2.6	83.6	13.3	0.4	0.0	100.0			

Table 8. Estimated sockeye salmon smolt emigration from the Chignik River, by age class and statistical week, 2002.

Statistical Week	Starting Date	Age 0.	Age 1.	Age 2.	Age 3.	Total
18	4/26	0	561,275	22,171	0	583,446
19	5/3	0	801,096	100,024	0	901,120
20	5/10	0	939,742	110,249	0	1,049,991
21	5/17	0	1,314,879	241,191	0	1,556,069
22	5/24	0	6,043,968	989,656	35,345	7,068,969
23	5/31	15,985	2,685,469	479,548	15,985	3,196,987
24	6/7	110,873	1,017,418	156,526	19,566	1,304,383
25	6/14	184,924	318,875	89,498	0	593,297
26	6/21	65,737	158,543	32,224	1,289	257,793
27	6/28	34,909	107,636	2,909	0	145,454
28	7/5	28,520	31,522	0	0	60,043
Total		440,947	13,980,423	2,223,996	72,184	16,717,551

Table 9. Chignik River sockeye salmon escapement, estimated number of smolts by freshwater age, smolt per spawner, adult return by freshwater age, return per spawner, marine survival, by brood year, 1991 to 2002.

		Smolt Produced							Adult Return							
Brood Year	Escapement	age 0.	age 1.	age 2.	age 3.	age 4.	Total smolt	Smolt / spawner	Age 0.	Age 1.	Age 2.	Age 3.	Other	Total	Return / spawner	Marine Survival
1991	1,040,098	NA	NA	4,270,636	0	0	4,270,636	4.11	3,570	1,708,052	718,400	10,806	4,577	2,445,405	2.35	NA
1992	766,603	NA	7,263,054	5,178,450	5,018	0	12,446,522	16.24	138,761	649,860	1,100,542	93,435	982	1,983,580	2.59	16%
1993	697,377	0	2,843,222	731,099	122,289	0	3,696,610	5.30	17,489	404,651	2,000,010	7,675	155	2,429,980	3.48	66%
1994	964,354	735,916	1,200,793	13,738,356	158,056	0	15,833,121	16.42	313	1,806,184	1,445,783	2,320	793	3,255,393	3.38	21%
1995	739,920	80,254	11,172,150	20,374,245	78,798	0	31,705,447	42.85	38,229	2,435,327	968,399	18,144		3,460,099	4.68	11%
1996	735,112	528,846	5,790,587	8,221,631	160,017	5,671	14,706,752	20.01	128,029	1,954,243	860,687					
1997	775,618	75,560	12,705,935	4,645,121	516,723	0	17,943,339	23.13	14,543	786,766						
1998	701,128	73,364	8,047,526	5,024,666	72,184		13,217,740	18.85	5,787							
1999	715,966	1,270,101	18,940,752	2,223,996			22,434,849	31.34								
2000	805,275	521,546	13,980,423				14,501,969									
2001	1,136,918	440,947														
2002	725,220															

Table 10. Estimated marine survival of sockeye salmon smolts from the Chignik River, by emigration year and freshwater age, 1994 to 2002.

Emigration Year	Smolt Estimates Age 0.	Age 1.	Age 2.	Age 3.	Total	Adult Returns Age 0.	Age 1.	Age 2.	Age 3.	Total	Marine Survival
1994	0	7,263,054	4,270,636	0	11,533,690	17,489	649,860	718,400	24,101	1,409,850	12%
1995	735,916	2,843,222	5,178,450	0	8,757,588	313	404,651	1,100,542	10,806	1,516,312	17%
1996	80,245	1,200,793	731,099	5,018	2,017,155	38,229	1,806,184	2,000,010	93,435	3,937,858	195%
1997	528,846	11,172,150	13,738,356	122,289	25,561,641	128,029	2,435,327	1,445,783	7,675	4,016,814	16%
1998	75,560	5,790,587	20,374,245	158,056	26,398,448	14,543	1,954,243	968,399	2,320	2,939,505	11%
1999[a]	73,364	12,705,935	8,221,631	78,798	21,079,728	5,787	786,766	860,687	18,144	1,671,384	8%
2000	1,270,101	8,047,526	4,645,121	160,017	14,122,765						
2001	521,546	18,940,752	5,024,666	516,723	25,003,687						
2002	440,947	13,980,423	2,223,996	72,184	16,717,551						

[a] 1999 smolt year not yet fully recruited because the age x.4 component of the run has yet to return.

Table 11. Estimated marine survival of sockeye salmon smolts from the Chignik River, by emigration year and ocean age, 1994 to 2002.

Emigration	Smolt estimates					Adult returns					
Year	Age 0.	Age 1.	Age 2.	Age 3.	Total	Age .1	Age .2	Age .3	Age .4	Total	Survival
1994	0	7,263,054	4,270,636	0	11,533,690	3,492	216,654	1,180,530	9,174	1,409,850	12%
1995	735,916	2,843,222	5,178,450	0	8,757,588	23,193	335,462	1,153,544	4,113	1,516,312	17%
1996	80,245	1,200,793	731,099	5,018	2,017,155	20,762	652,836	3,244,567	19,693	3,937,858	195%
1997	528,846	11,172,150	13,738,356	122,289	25,561,641	10,875	1,211,950	2,780,125	13,864	4,016,814	16%
1998	75,560	5,790,587	20,374,245	158,056	26,398,448	622	156,443	2,749,174	33,266	2,939,505	11%
1999	73,364	12,705,935	8,221,631	78,798	21,079,728	260	145,459	1,525,665		1,671,384	8%
2000	1,270,101	8,047,526	4,645,121	160,017	14,122,765	5,105	414,528				
2001	521,546	18,940,752	5,024,666	516,723	25,003,687	283					
2002	440,947	13,980,423	2,223,996	72,184	16,717,551						

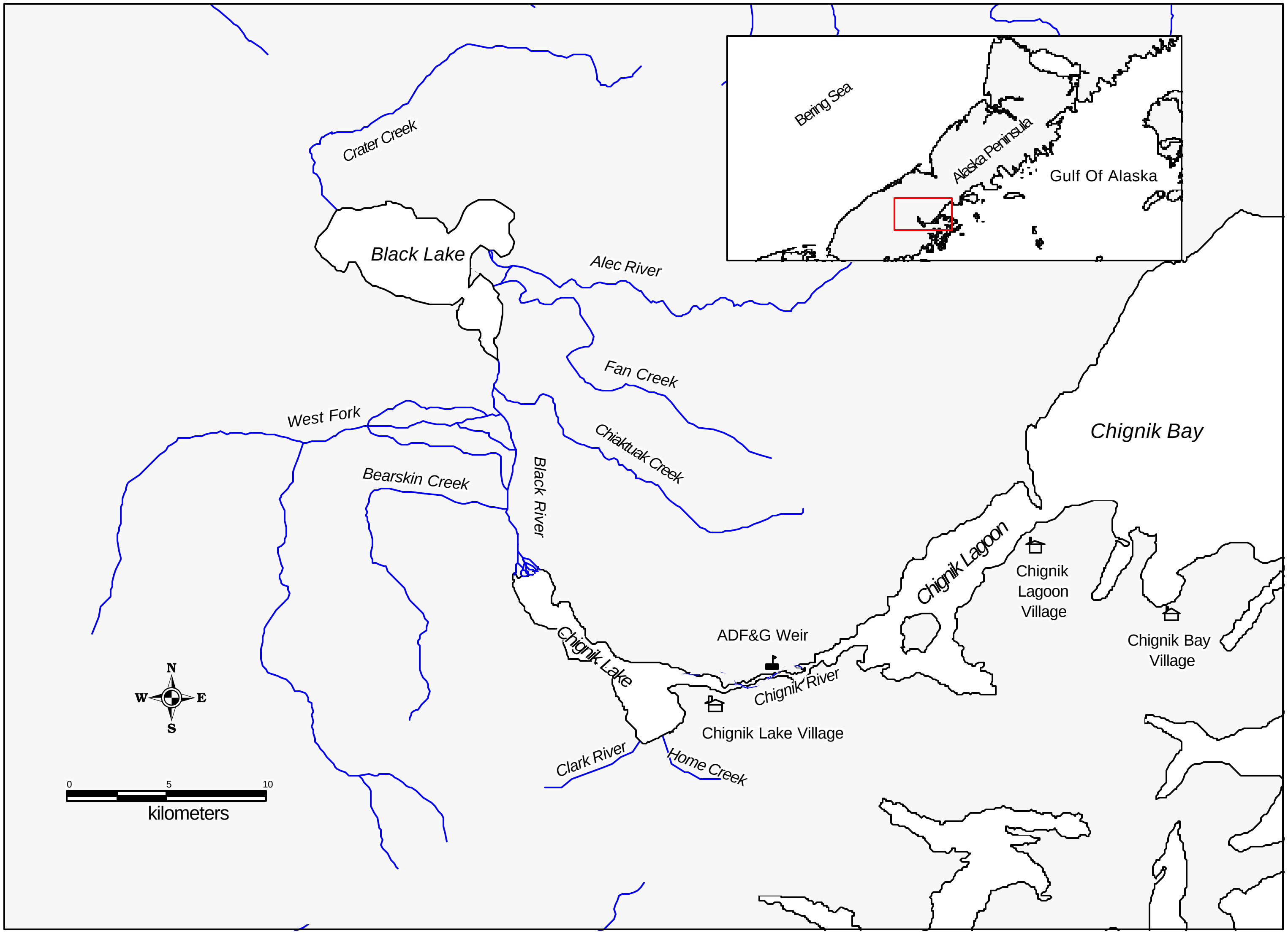

Figure 1. Map of the Chignik River watershed with inset of the Alaska Peninsula.

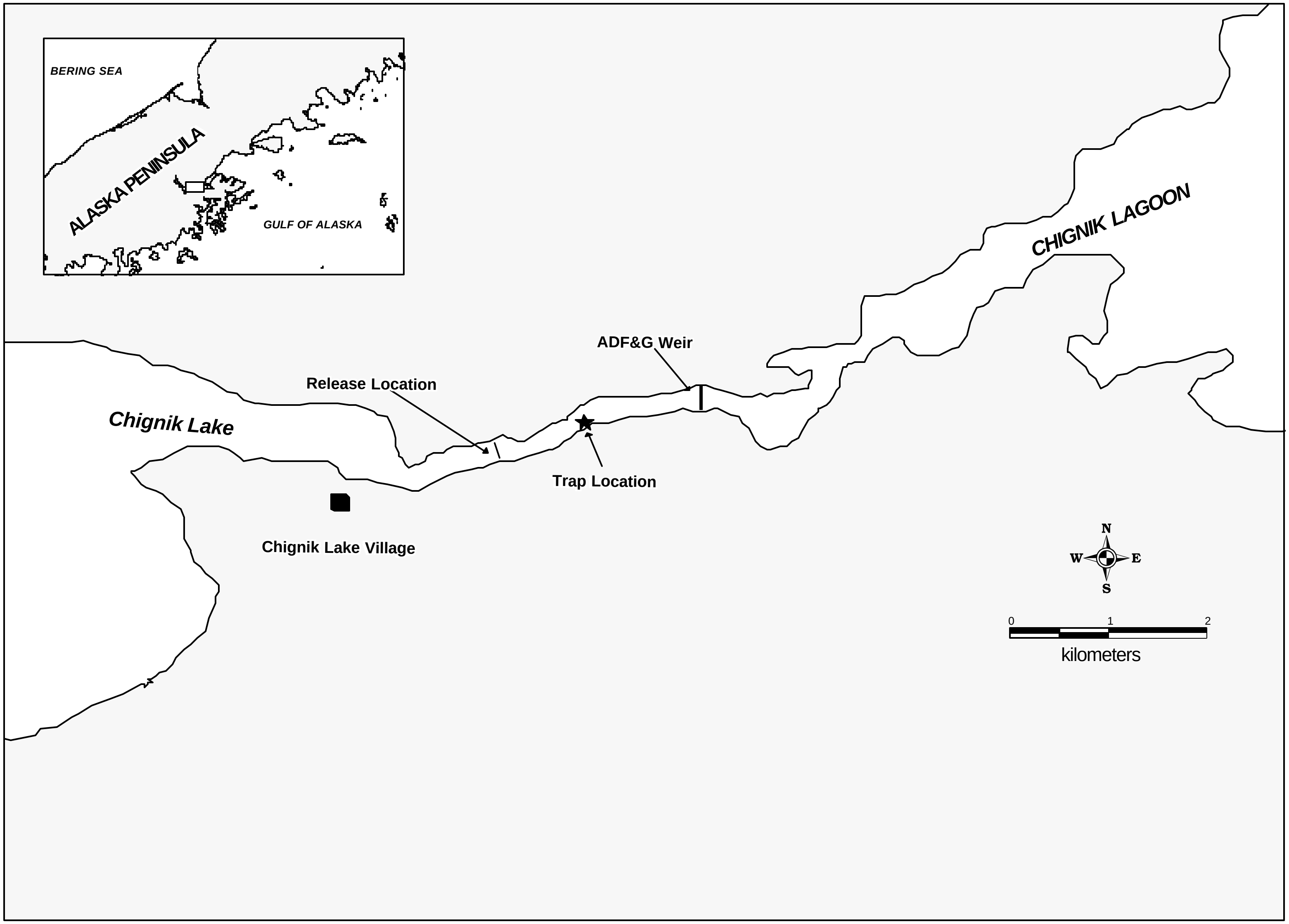

Figure 2. Location of the traps and the release site of marked smolt on the Chignik River, Alaska, 2002.

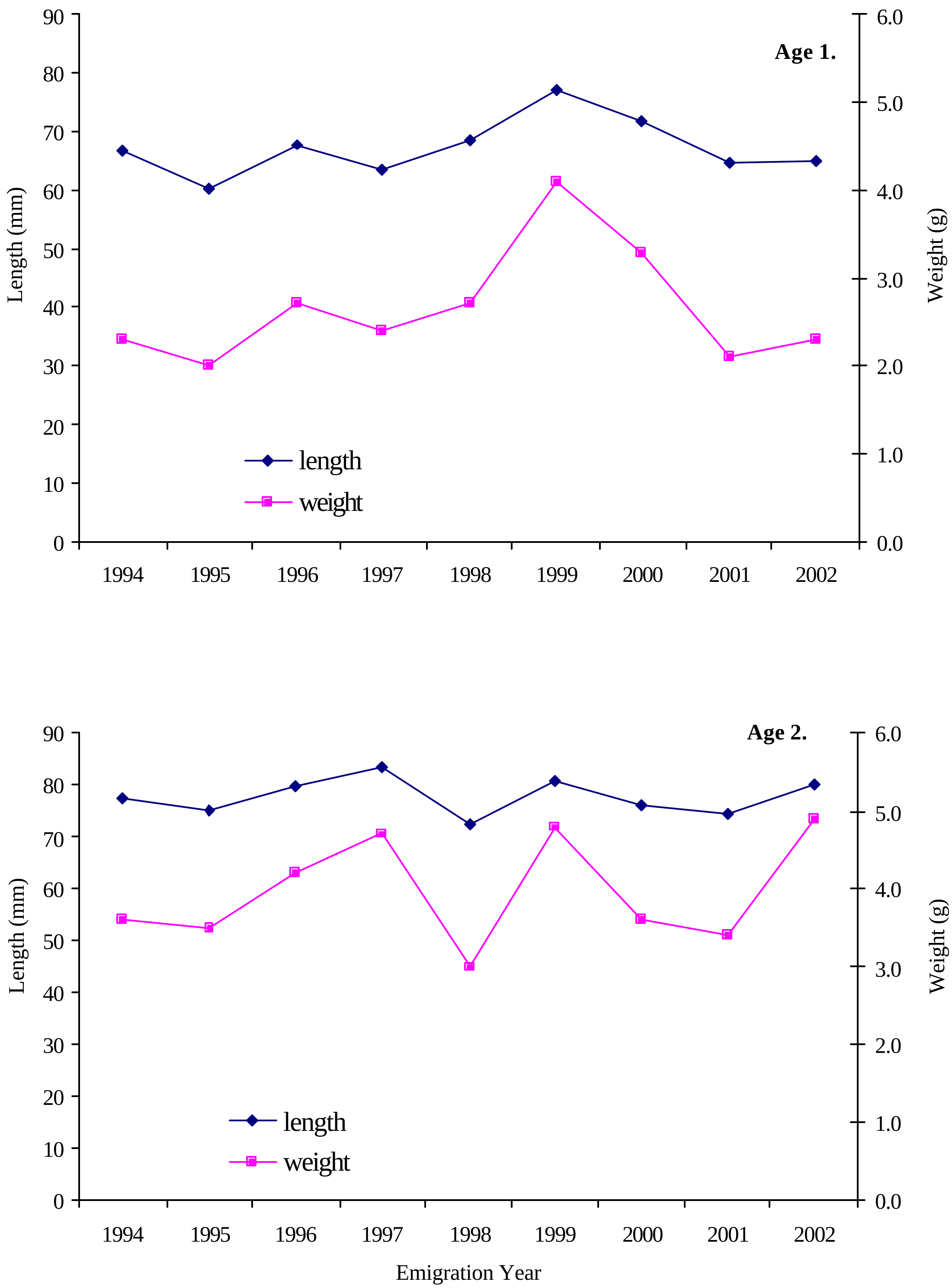

Figure 3. Average length and weight of age 1. and age 2. sockeye salmon, by year, 1994 through 2002.

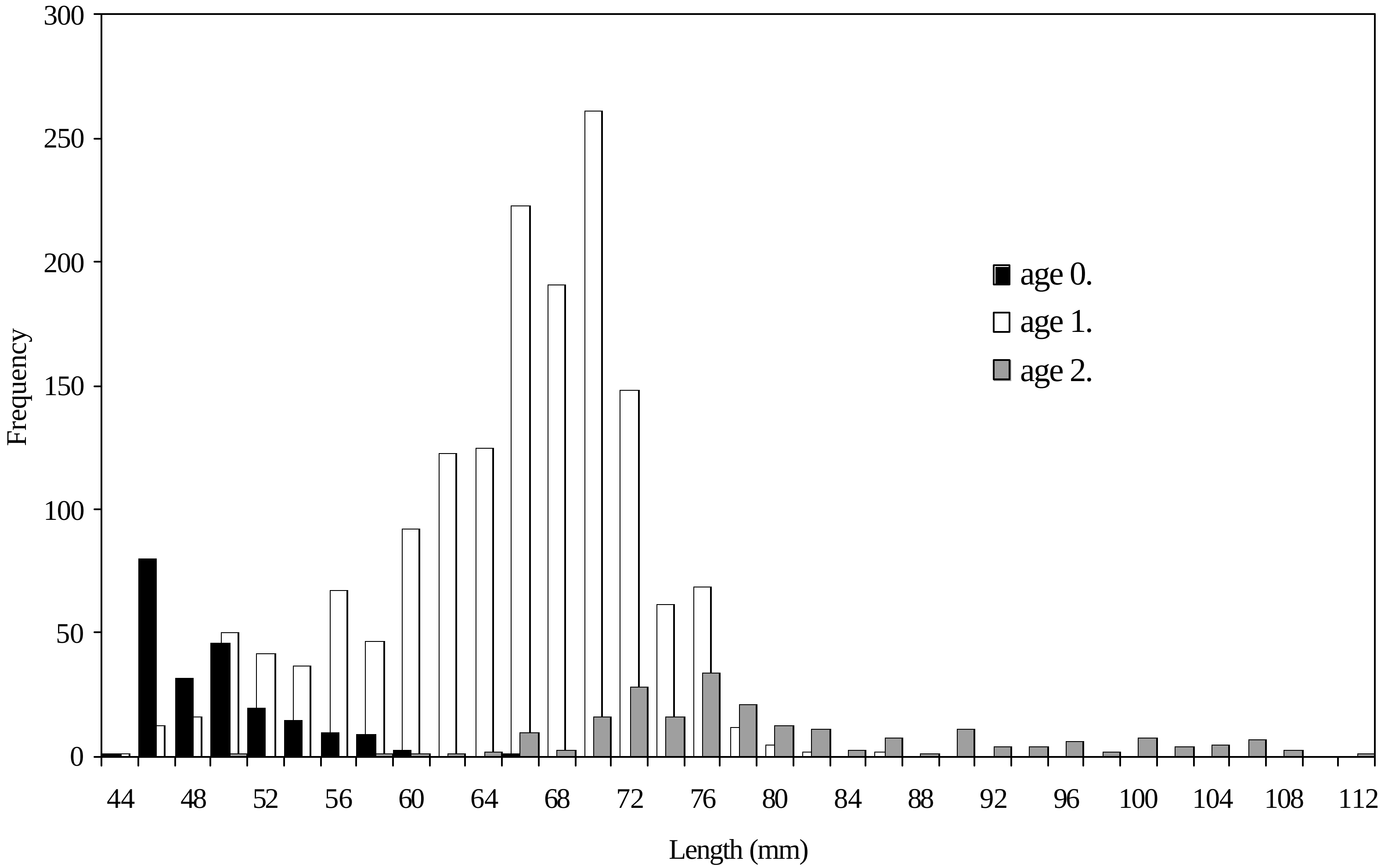

Figure 4. Length frequency histogram of age 0., 1., and 2. sockeye salmon smolts sampled from the Chignik River, 2002.

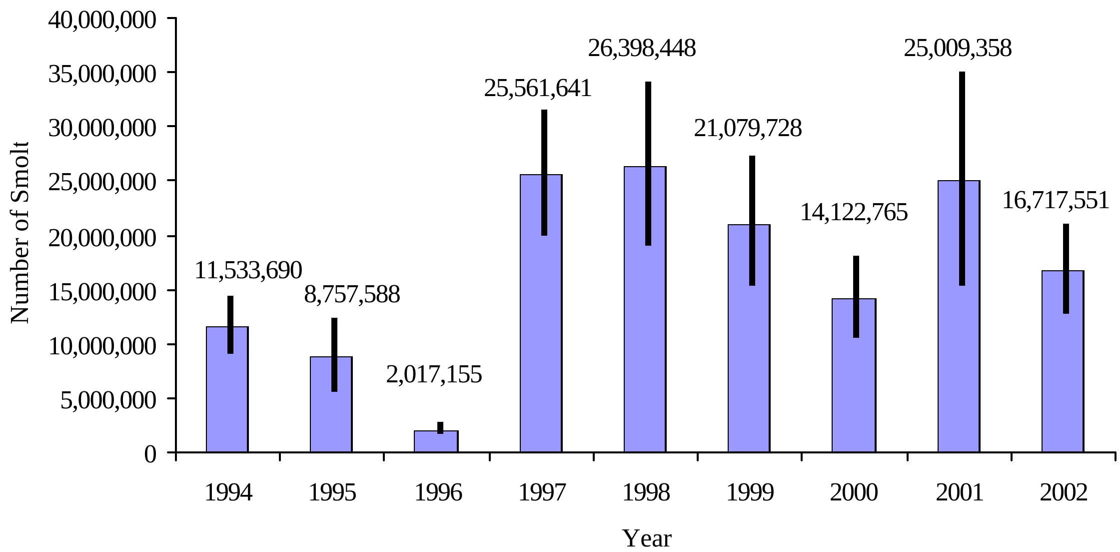

Figure 5. Annual Chignik River sockeye salmon smolt emigration estimates and corresponding 95% confidence intervals, 1994 to 2002.

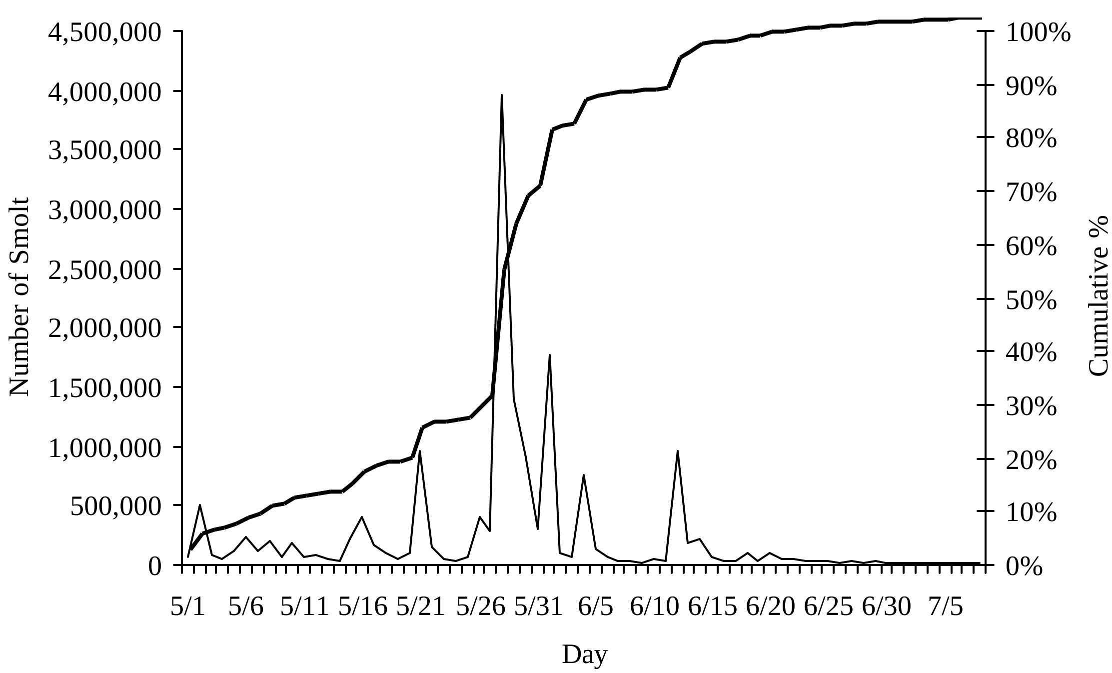

Figure 6. Estimated daily and corresponding cumulative percentage of the sockeye salmon smolt emigration from the Chignik River, 2002.

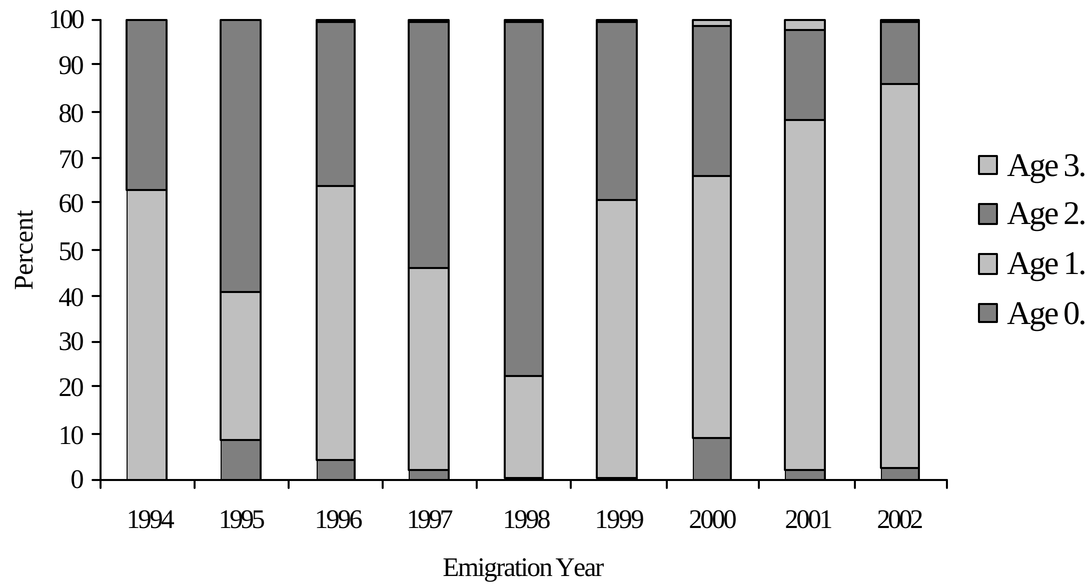

Figure 7. A comparison of the estimated age structure of age 0. to age 3. sockeye salmon smolt emigrations from the Chignik River, 1994 to 2002.

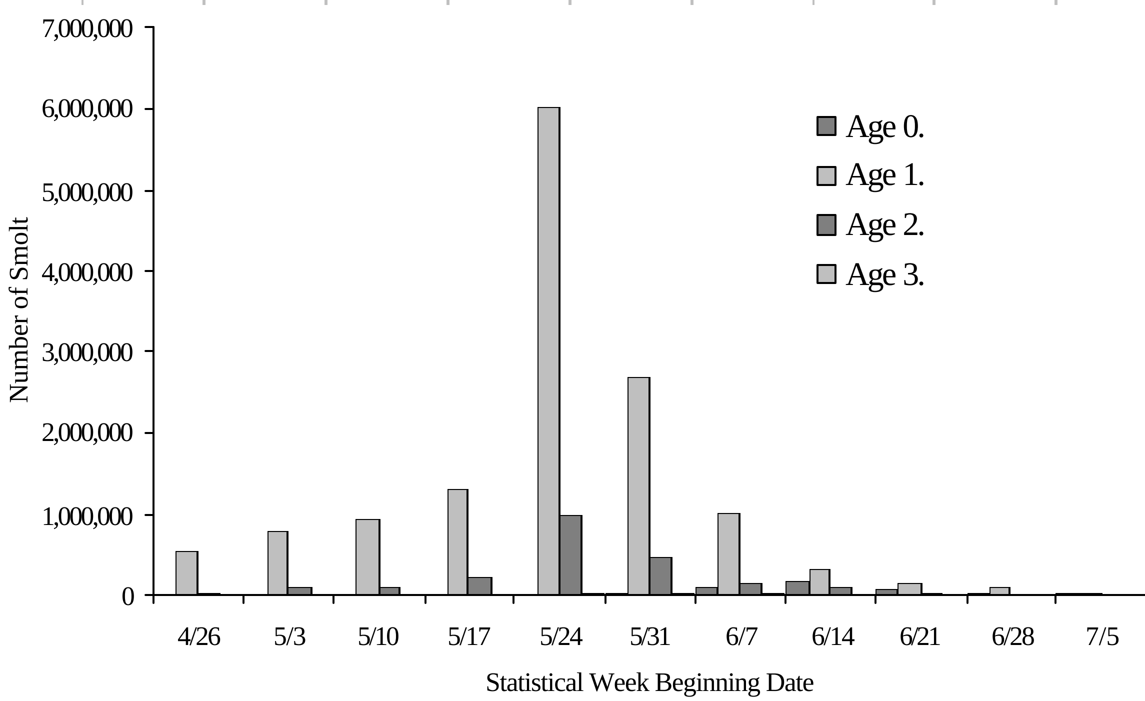

Figure 8. Estimated smolt emigration of age 0. to age 3. sockeye salmon smolts, by statistical week beginning date, from the Chignik River, 2002.

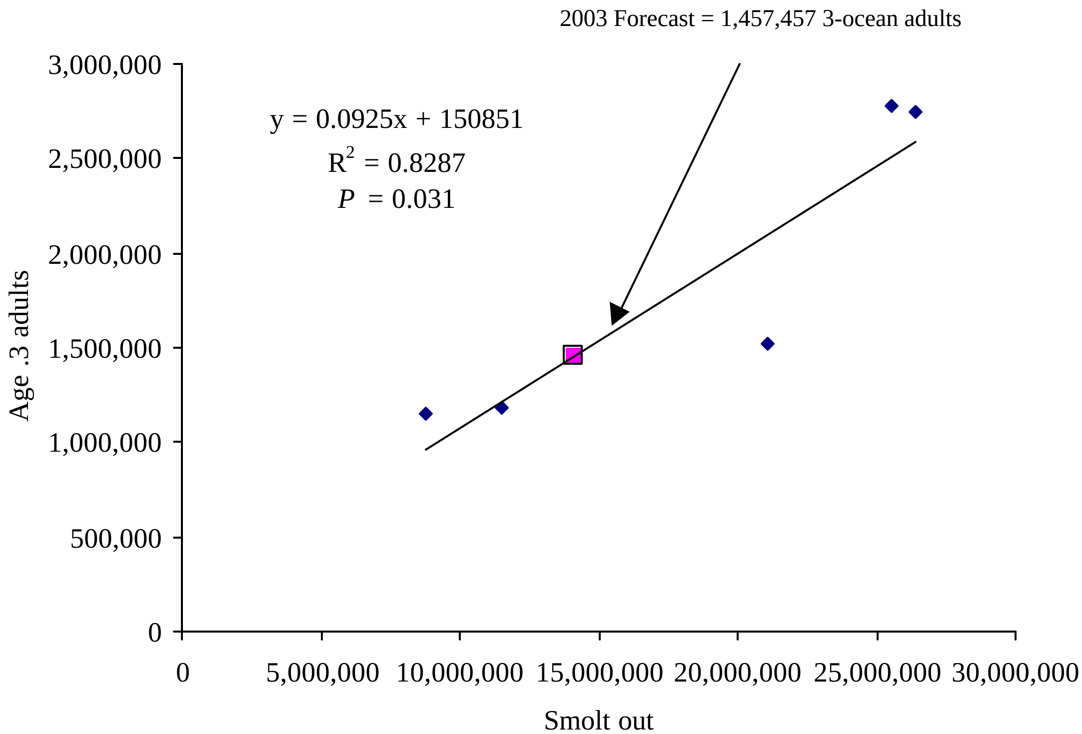

Figure 9. Regression relationship between the total Chignik River sockeye salmon smolt emigration estimate, by emigration year, and 3-ocean adult returns, with the predicted 2003 return indicated.

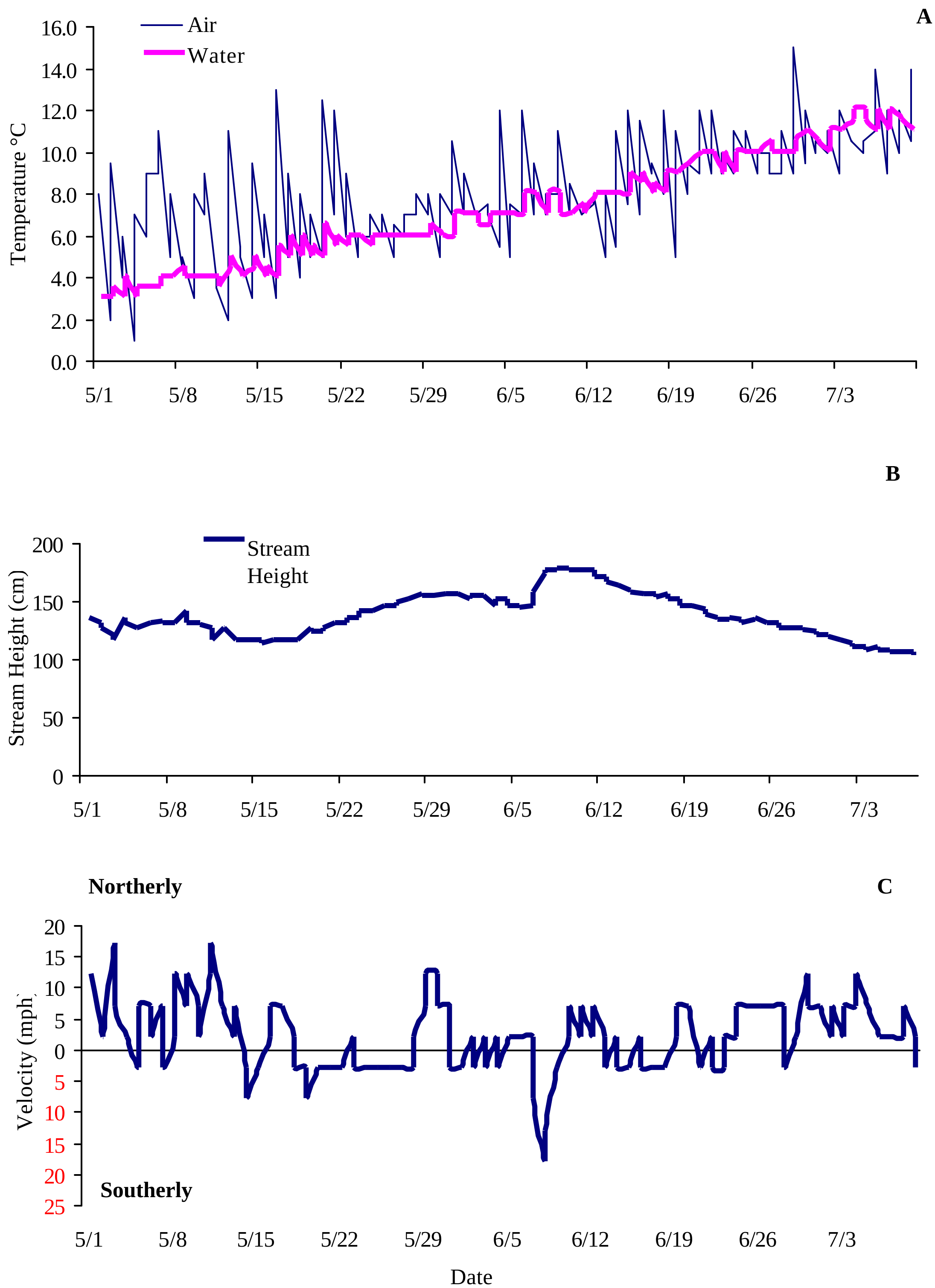

Figure 10. Air and water temperature (A), stream gauge height (B), and wind velocity and direction data (C) gathered at the Chignik River smolt traps, 2002.

APPENDIX

Appendix A. Actual daily counts and trap efficiency data of the Chignik River sockeye salmon smolt project, 2002.

	Actual		Trap Efficiency Test				Incidental Catch[a]											
Date	Daily	Cum.	Marked	Daily Recoveries	Cum. Recoveries	Efficiency[b]	Soc Fry	Coho	Pink	DV	SB	Chnk	PS	PW	SF	SC	ISO	BLK
5/1	514	514					861	2	0	17	237	8	0	2	0	12	0	0
5/2	3,478	3,992					1,535	2	0	56	208	199	14	1	1	35	0	0
5/3	587	4,579	1,899	6	6	0.37%	1,135	0	0	14	188	16	11	0	5	15	1	1
5/4	375	4,954		2	8	0.47%	810	2	0	10	160	6	36	0	2	15	3	0
5/5	858	5,812		0	8	0.47%	806	3	140	9	192	13	12	0	2	40	2	0
5/6	1,627	7,439		4	12	0.68%	955	8	131	8	250	5	12	0	5	52	0	0
5/7	853	8,292		0	12	0.68%	908	7	110	1	105	3	6	0	0	3	0	0
5/8	1,420	9,712		0	12	0.68%	1,518	48	44	8	189	4	2	0	0	21	0	0
5/9	814	10,526	2,239	22	22	1.03%	518	6	21	2	30	1	1	0	0	0	3	0
5/10	2,273	12,799		3	25	1.16%	5,008	58	68	6	258	1	2	0	1	53	0	0
5/11	811	13,610		0	25	1.16%	893	15	15	1	64	0	0	0	1	36	0	1
5/12	1,137	14,747		1	26	1.21%	577	4	35	5	54	0	5	0	2	38	0	0
5/13	659	15,406		1	27	1.25%	393	15	71	4	32	2	6	0	1	13	0	0
5/14	346	15,752		0	27	1.25%	296	3	20	5	9	1	2	0	1	14	0	0
5/15	2,742	18,494		0	27	1.25%	336	30	0	4	49	2	1	0	0	20	0	0
5/16	1,035	19,529	1,992	4	4	0.25%	405	28	7	6	104	1	2	0	5	23	0	0
5/17	438	19,967		0	4	0.25%	476	17	16	1	74	1	1	0	0	21	1	0
5/18	235	20,202		0	4	0.25%	354	24	28	7	39	0	4	0	0	24	1	0
5/19	109	20,311		0	4	0.25%	290	31	4	3	48	2	0	0	1	8	0	0
5/20	256	20,567		0	4	0.25%	308	33	40	3	73	0	2	0	1	13	3	0
5/21	2,396	22,963		0	4	0.25%	285	34	15	10	36	2	1	0	0	22	0	0
5/22	363	23,326		0	4	0.25%	270	24	14	17	31	0	2	0	0	16	0	0
5/23	227	23,553	1,875	8	8	0.48%	391	79	12	2	24	0	1	0	0	9	2	0
5/24	202	23,755		0	8	0.48%	288	45	85	20	72	0	3	0	0	15	2	1
5/25	349	24,104		0	8	0.48%	333	64	161	12	88	3	3	0	0	8	5	0
5/26	2,127	26,231		1	9	0.53%	177	27	6	8	77	2	6	0	0	15	0	0
5/27	1,525	27,756		0	9	0.53%	265	31	90	29	82	0	4	0	1	28	0	0
5/28	21,114	48,870		0	9	0.53%	215	36	0	64	83	1	0	1	0	15	0	0
5/29	8,195	57,065	2,908	16	16	0.58%	148	59	5	73	76	0	4	0	3	38	9	0

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	Actual		Trap Efficiency Test				Incidental Catch[a]											
Date	Daily	Cum.	Marked	Daily Recoveries	Cum. Recoveries	Efficiency[b]	Soc Fry	Coho	Pink	DV	SB	Chnk	PS	PW	SF	SC	ISO	BLK
5/30	5,360	62,425		0	16	0.58%	193	46	5	14	67	0	2	0	6	10	3	0
5/31	1,754	64,179		0	16	0.58%	486	34	0	32	29	0	1	1	0	24	3	0
6/1	10,388	74,567		0	16	0.58%	324	29	0	27	20	3	4	0	0	40	1	0
6/2	584	75,151		0	16	0.58%	398	23	0	6	67	0	2	0	0	12	0	0
6/3	358	75,509		0	16	0.58%	227	8	25	11	44	0	6	0	0	6	0	0
6/4	4,410	79,919		0	16	0.58%	166	20	0	22	49	3	1	0	1	10	1	0
6/5	3,208	83,127	2,223	45	45	2.07%	634	18	0	19	160	3	2	0	1	11	5	0
6/6	1,732	84,859		5	50	2.29%	269	9	0	20	82	6	1	2	0	9	7	0
6/7	684	85,543		2	52	2.38%	381	25	0	18	99	0	1	0	2	51	11	0
6/8	868	86,411		0	52	2.38%	209	58	6	29	67	2	1	0	0	17	6	0
6/9	304	86,715		1	53	2.43%	119	30	0	41	68	0	7	8	1	16	1	0
6/10	1,336	88,051		0	53	2.43%	95	51	0	17	52	0	8	0	0	18	4	0
6/11	765	88,816		0	53	2.43%	515	22	0	22	153	0	0	0	0	0	0	0
6/12	23,376	112,192		0	53	2.43%	1,660	59	0	52	366	0	3	0	3	16	9	0
6/13	3,864	116,056	2,126	42	42	2.02%	691	13	0	30	44	0	1	0	0	17	7	0
6/14	4,864	120,920		3	45	2.16%	856	10	0	34	72	0	0	1	0	38	10	0
6/15	1,385	122,305		0	45	2.16%	290	27	0	14	62	0	3	0	0	10	10	0
6/16	568	122,873		0	45	2.16%	388	15	0	30	135	1	1	6	4	12	7	0
6/17	889	123,762		0	45	2.16%	185	30	0	8	54	14	3	0	0	6	0	0
6/18	2,302	126,064		0	45	2.16%	587	18	0	11	96	11	1	1	0	0	1	0
6/19	763	126,827	1,379	23	23	1.74%	1,679	22	0	14	215	2	1	1	0	4	3	0
6/20	2,156	128,983		7	30	2.25%	984	15	0	18	159	3	5	0	0	8	2	0
6/21	999	129,982		0	30	2.25%	141	23	0	15	58	1	2	0	0	6	20	0
6/22	1,285	131,267		0	30	2.25%	147	14	0	11	126	0	1	0	0	17	0	1
6/23	819	132,086		0	30	2.25%	101	29	0	23	86	7	1	0	0	8	2	0
6/24	778	132,864		0	30	2.25%	108	20	0	10	107	0	0	0	1	9	0	0
6/25	758	133,622		0	30	2.25%	61	27	0	18	37	0	1	0	0	7	4	0
6/26	506	134,128		0	30	2.25%	68	28	0	6	104	0	0	0	1	14	0	0
6/27	646	134,774		0	30	2.25%	121	33	0	7	34	2	5	0	0	13	6	0
6/28	535	135,309		0	30	2.25%	87	7	0	3	50	0	5	0	0	0	3	0

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Appendix A. (page 3 of 3)

Date	Actual Daily	Actual Cum.	Trap Efficiency Test Marked	Daily Recoveries	Cum. Recoveries	Efficiency[b]	Soc Fry	Coho	Pink	DV	SB	Chnk	PS	PW	SF	SC	ISO	BLK
6/29	403	135,712	1,269	12	12	1.02%	30	16	0	7	64	0	4	0	0	10	0	0
6/30	269	135,981		4	16	1.34%	23	16	0	8	53	0	7	0	0	11	0	0
7/1	295	136,276		1	17	1.42%	40	14	0	4	47	0	2	0	0	10	2	0
7/2	258	136,534		0	17	1.42%	29	11	0	3	56	0	0	0	0	8	0	0
7/3	293	136,827		0	17	1.42%	51	21	0	11	101	0	4	0	0	0	6	0
7/4	206	137,033		0	17	1.42%	24	13	0	10	54	1	2	0	0	10	2	0
7/5	266	137,299		0	17	1.42%	10	5	0	3	29	0	3	0	0	4	0	0
7/6	218	137,517		0	17	1.42%	32	14	0	5	44	0	4	0	0	10	0	0
7/7	212	137,729		0	17	1.42%	21	10	0	12	26	5	7	0	0	2	5	0
7/8	155	137,884		0	17	1.42%	18	5	0	3	32	0	2	0	0	8	1	0
Total		137,884	17,910	213	213	1.19%	33,202	1,623	1,174	1,053	6,200	337	247	24	52	1,104	174	4

Soc Fry through BLK are Incidental Catch[a] columns.

[a] Soc Fry = sockeye salmon fry, coho = juvenile coho salmon, pink = juvenile pink salmon, chnk = juvenile chinook salmon, DV = Dolly Varden, SB = stickleback, PS = pond smelt, PW = pigmy whitefish, SF = starry flounder, SC = sculpin, ISO = isopods, BLK - Alaska blackfish.

[b] Calculated by: = {(R+1)/(M+1)}*100
where: R = number of marked fish recaptured, and;
M = number of marked fish (Carlson et al. 1998).

Appendix B. Number of sockeye salmon smolts caught by trap, by day, from the Chignik River, May 1 to July 8, 2002.

	Small Trap		Large Trap		Combined		Percent Total	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Small	Large
5/1	272	272	242	242	514	514	52.9	47.1
5/2	1,266	1,538	2,212	2,454	3,478	3,992	36.4	63.6
5/3	255	1,793	332	2,786	587	4,579	43.4	56.6
5/4	149	1,942	226	3,012	375	4,954	39.7	60.3
5/5	329	2,271	529	3,541	858	5,812	38.3	61.7
5/6	723	2,994	904	4,445	1,627	7,439	44.4	55.6
5/7	274	3,268	579	5,024	853	8,292	32.1	67.9
5/8	492	3,760	928	5,952	1,420	9,712	34.6	65.4
5/9	274	4,034	540	6,492	814	10,526	33.7	66.3
5/10	646	4,680	1,627	8,119	2,273	12,799	28.4	71.6
5/11	182	4,862	629	8,748	811	13,610	22.4	77.6
5/12	255	5,117	882	9,630	1,137	14,747	22.4	77.6
5/13	146	5,263	513	10,143	659	15,406	22.2	77.8
5/14	69	5,332	277	10,420	346	15,752	19.9	80.1
5/15	293	5,625	2,449	12,869	2,742	18,494	10.7	89.3
5/16	126	5,751	909	13,778	1,035	19,529	12.2	87.8
5/17	78	5,829	360	14,138	438	19,967	17.8	82.2
5/18	41	5,870	194	14,332	235	20,202	17.4	82.6
5/19	17	5,887	92	14,424	109	20,311	15.6	84.4
5/20	29	5,916	227	14,651	256	20,567	11.3	88.7
5/21	311	6,227	2,085	16,736	2,396	22,963	13.0	87.0
5/22	29	6,256	334	17,070	363	23,326	8.0	92.0
5/23	63	6,319	164	17,234	227	23,553	27.8	72.2
5/24	39	6,358	163	17,397	202	23,755	19.3	80.7
5/25	82	6,440	267	17,664	349	24,104	23.5	76.5
5/26	325	6,765	1,802	19,466	2,127	26,231	15.3	84.7
5/27	272	7,037	1,253	20,719	1,525	27,756	17.8	82.2
5/28	5,276	12,313	15,838	36,557	21,114	48,870	25.0	75.0
5/29	2,112	14,425	6,083	42,640	8,195	57,065	25.8	74.2
5/30	894	15,319	4,466	47,106	5,360	62,425	16.7	83.3
5/31	346	15,665	1,408	48,514	1,754	64,179	19.7	80.3
6/1	2,415	18,080	7,973	56,487	10,388	74,567	23.2	76.8
6/2	135	18,215	449	56,936	584	75,151	23.1	76.9
6/3	87	18,302	271	57,207	358	75,509	24.3	75.7
6/4	872	19,174	3,538	60,745	4,410	79,919	19.8	80.2
6/5	301	19,475	2,907	63,652	3,208	83,127	9.4	90.6
6/6	163	19,638	1,569	65,221	1,732	84,859	9.4	90.6
6/7	119	19,757	565	65,786	684	85,543	17.4	82.6
6/8	218	19,975	650	66,436	868	86,411	25.1	74.9
6/9	49	20,024	255	66,691	304	86,715	16.1	83.9
6/10	333	20,357	1,003	67,694	1,336	88,051	24.9	75.1
6/11	143	20,500	622	68,316	765	88,816	18.7	81.3
6/12	1,592	22,092	21,784	90,100	23,376	112,192	6.8	93.2
6/13	477	22,569	3,387	93,487	3,864	116,056	12.3	87.7
6/14	676	23,245	4,188	97,675	4,864	120,920	13.9	86.1
6/15	275	23,520	1,110	98,785	1,385	122,305	19.9	80.1

-Continued-

Appendix B. (page 2 of 2)

	Small Trap		Large Trap		Combined		Percent Total	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Small	Large
6/16	121	23,641	447	99,232	568	122,873	21.3	78.7
6/17	87	23,728	802	100,034	889	123,762	9.8	90.2
6/18	100	23,828	2,202	102,236	2,302	126,064	4.3	95.7
6/19	90	23,918	673	102,909	763	126,827	11.8	88.2
6/20	138	24,056	2,018	104,927	2,156	128,983	6.4	93.6
6/21	136	24,192	863	105,790	999	129,982	13.6	86.4
6/22	104	24,296	1,181	106,971	1,285	131,267	8.1	91.9
6/23	117	24,413	702	107,673	819	132,086	14.3	85.7
6/24	109	24,522	669	108,342	778	132,864	14.0	86.0
6/25	120	24,642	638	108,980	758	133,622	15.8	84.2
6/26	104	24,746	402	109,382	506	134,128	20.6	79.4
6/27	84	24,830	562	109,944	646	134,774	13.0	87.0
6/28	106	24,936	429	110,373	535	135,309	19.8	80.2
6/29	110	25,046	293	110,666	403	135,712	27.3	72.7
6/30	95	25,141	174	110,840	269	135,981	35.3	64.7
7/1	70	25,211	225	111,065	295	136,276	23.7	76.3
7/2	73	25,284	185	111,250	258	136,534	28.3	71.7
7/3	79	25,363	214	111,464	293	136,827	27.0	73.0
7/4	60	25,423	146	111,610	206	137,033	29.1	70.9
7/5	66	25,489	200	111,810	266	137,299	24.8	75.2
7/6	51	25,540	167	111,977	218	137,517	23.4	76.6
7/7	54	25,594	158	112,135	212	137,729	25.5	74.5
7/8	28	25,622	127	112,262	155	137,884	18.1	81.9

Appendix C. Daily climatological observations for the Chignik River sockeye salmon smolt project, 2002.

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover %	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Large	Stream Gauge (cm)	Comments
5/1	12:05	8.0	3.0	50	NW	10	9.00	7.50	N/A	Traps Fishing
5/2	0:15	2.0	3.0	0		0	8.00	7.38	N/A	Clear
5/2	12:10	9.5	3.5	80		0	8.00	7.50	N/A	Overcast
5/3	0:00	4.0	3.0	80	NW	15	9.25	7.38	N/A	Overcast
5/3	12:00	6.0	4.0	95	NW	5	9.00	7.75	130	Overcast
5/4	0:00	1.0	3.0	25		0	9.00	8.50	125	Dye Release
5/4	12:00	7.0	3.5	100		0	9.00	8.00	120	Overcast
5/5	0:00	6.0	3.5	100	SE	5	8.00	6.38	115	Overcast
5/5	12:00	9.0	3.5	100	NW	5	9.25	7.00	110	Overcast
5/6	0:00	9.0	3.5	100	NW	5	8.50	7.00	130	Overcast
5/6	12:00	11.0	4.0	15		0	8.50	7.50	125	Overcast
5/7	0:00	5.0	4.0	85	NW	5	8.50	7.00	120	Overcast
5/7	12:00	8.0	4.0	100	SE	5	8.00	7.00	120	Overcast
5/8	0:00	4.5	4.5	60		0	8.50	8.00	125	Partly Clear
5/8	12:09	5.0	4.0	90	NW	10	8.50	8.00	125	Overcast
5/9	0:10	3.0	4.0	100	NW	5	8.50	7.00	127	Overcast
5/9	12:10	8.0	4.0	75	NW	10	8.50	7.00	125	Overcast
5/10	0:00	7.0	4.0	85	NW	5	8.75	7.38	125	Dye Release/Overcast
5/10	12:00	9.0	4.0	100		0	8.00	7.00	125	Overcast
5/11	0:00	4.0	4.0	100	NW	10	8.00	7.00	135	Overcast
5/11	12:10	3.5	3.5	10	NW	15	8.00	7.00	125	Snow
5/12	0:00	2.0	4.5	0	NW	5	8.25	7.00	125	Sunny
5/12	12:00	11.0	5.0	5	NW	5	8.00	7.00	123	Sunny
5/13	0:00	5.5	4.0	100		0	6.75	6.75	120	Overcast
5/13	12:15	5.0	4.0	100	NW	5	7.50	7.00	110	Overcast
5/14	0:05	3.0	4.5	20	SE	5	7.25	7.50	121	Clear
5/14	12:00	9.5	5.0	40	SE	10	7.00	6.13	120	Mostly Clear
5/15	0:15	5.0	4.0	30	SE	5	6.75	6.13	110	Clear
5/15	12:00	7.0	4.5	100	SE	5	7.00	6.00	110	Overcast

-Continued-

Appendix C. (page 2 of 5)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover (%)	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Large	Stream Gauge (cm)	Comments
5/16	0:00	3.0	4.0	30		0	7.00	6.00	110	Mostly Clear
5/16	12:00	13.0	5.5	30	NW	5	7.00	6.00	110	Mostly Clear
5/17	0:05	5.0	5.0	0	NW	5	6.75	6.00	110	Clear
5/17	12:00	9.0	6.0	0	NW	5	7.00	6.13	108	Clear
5/18	0:00	4.0	5.0	0		0	7.00	7.00	110	Clear
5/18	12:00	8.0	6.0	100	SE	5	7.00	6.13	110	Overcast
5/19	0:00	5.0	5.0	100	SE	5	7.00	6.00	110	Overcast
5/19	12:00	7.0	5.5	100	SE	10	7.00	6.00	110	Breezy, Overcast
5/20	0:00	5.0	5.0	100	SE	5	7.00	6.13	110	Overcast
5/20	12:00	12.5	6.5	0	SE	5	7.00	6.25	110	Sunny
5/21	0:00	7.0	5.5	40	SE	5	7.50	6.25	120	Mostly Clear
5/21	12:00	12.0	6.0	10	SE	15	7.50	6.50	118	Clear
5/22	0:00	6.0	5.5	100	SE	5	7.75	6.75	118	Overcast
5/22	12:00	9.0	6.0	100	SE	5	8.25	7.00	120	Overcast
5/23	0:00	5.0	6.0	100		0	9.00	7.00	125	Overcast
5/23	12:00	6.0	6.0	100	SE	5	8.25	7.13	125	Rain
5/24	0:00	6.0	5.5	100	SE	5	8.25	6.75	125	Overcast
5/24	12:00	7.0	6.0	100	SE	5	8.50	7.13	130	Overcast
5/25	0:00	6.0	6.0	100	SE	5	8.25	7.38	130	Overcast
5/25	12:00	7.0	6.0	100	SE	5	9.00	7.38	135	Overcast
5/26	0:00	5.0	6.0	100	SE	5	9.00	7.38	135	Overcast
5/26	12:00	6.5	6.0	100	SE	5	9.25	7.50	135	Overcast
5/27	0:00	6.0	6.0	100	SE	5	9.50	8.00	140	Rain
5/27	12:00	7.0	6.0	100	SE	5	9.50	8.00	140	Rain
5/28	0:00	7.0	6.0	100	SE	5	10.00	8.13	140	Rain
5/28	12:00	8.0	6.0	100		0	9.50	8.00	143	Overcast
5/29	0:00	7.0	6.0	95	NW	5	9.50	8.13	145	Overcast
5/29	12:00	8.0	6.5	100	NW	10	10.25	8.50	145	Overcast

-Continued-

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover (%)	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Large	Stream Gauge (cm)	Comments
5/30	0:00	5.0	6.0	100	NW	10	10.00	8.13	150	Overcast
5/30	12:00	8.0	6.0	100	NW	5	10.00	8.75	148	Overcast
5/31	0:00	7.0	6.0	100	NW	5	9.75	8.25	148	Overcast
5/31	12:00	10.5	7.0	80	SE	5	9.75	8.13	148	Mostly Cloudy
6/1	0:00	7.0	7.0	100	SE	5	9.50	8.25	150	Rain
6/1	12:00	9.0	7.0	100	SE	5	9.50	8.13	150	Overcast
6/2	0:00	7.0	7.0	100		0	9.50	7.75	150	Rain
6/2	12:00	7.0	6.5	100	SE	5	9.50	8.13	150	Rain
6/3	0:00	7.5	6.5	100		0	9.00	8.00	145	Rain
6/3	12:00	7.0	7.0	100	SE	5	9.25	8.00	148	Rain
6/4	0:00	5.5	7.0	25		0	9.25	7.13	148	Mostly Clear
6/4	12:00	12.0	7.0	50	SE	5	9.25	8.00	148	Overcast
6/5	0:00	5.0	7.0	20		0	9.00	8.00	140	Overcast
6/5	12:00	7.5	7.0	90		0	9.25	8.00	145	Overcast
6/6	0:00	7.0	7.0	90		0	9.25	7.75	145	Overcast
6/6	12:00	12.0	8.0	30		0	9.50	7.88	140	Mostly Clear
6/7	0:00	7.0	8.0	100		0	9.25	8.00	140	Rain
6/7	12:00	9.5	8.0	100	SE	10	9.25	8.00	138	Rain
6/8	0:00	7.0	7.0	100	SE	20	9.00	7.88	140	Windy, Rain
6/8	12:00	8.0	8.0	100	SE	15	10.25	8.38	152	Rain
6/9	0:00	8.0	8.0	100	SE	5	10.75	8.88	168	Rain
6/9	12:00	11.0	7.0	100	SE	5	11.25	9.25	170	Overcast
6/10	0:00	7.0	7.0	100		0	11.00	9.25	170	Overcast
6/10	12:00	8.5	7.0	100	NW	5	11.50	9.50	172	Overcast
6/11	0:00	7.0	7.5	100		0	12.00	9.25	172	Overcast
6/11	12:00	7.0	7.0	90	NW	5	11.75	9.25	171	Overcast
6/12	0:00	7.5	8.0	90		0	11.75	9.25	170	Overcast
6/12	12:00	8.0	8.0	45	NW	5	11.50	9.25	170	Mostly Clear
6/13	0:00	5.0	8.0	0		0	12.00	9.00	170	Clear

-Continued-

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover (%)	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Large	Stream Gauge (cm)	Comments
6/13	12:00	8.0	8.0	10	SE	5	11.75	8.88	165	Clear
6/14	0:00	5.5	8.0	0		0	12.00	9.00	165	Clear
6/14	12:00	11.0	8.0	50	SE	5	11.25	9.25	161	Partly Clear
6/15	0:00	7.5	8.0	30	SE	5	11.00	9.25	158	Mostly Clear
6/15	12:00	12.0	9.0	0	SE	5	11.00	9.00	158	Clear
6/16	0:00	7.0	8.5	0		0	11.00	8.38	153	Clear
6/16	12:00	11.5	9.0	0	SE	5	11.00	8.63	151	Clear
6/17	0:00	9.0	8.0	100	SE	5	10.75	8.75	150	Overcast
6/17	12:00	9.5	8.5	100	SE	5	11.00	8.63	150	Overcast
6/18	0:00	8.0	8.0	100	SE	5	11.00	8.38	150	Overcast
6/18	12:00	12.0	9.0	100	SE	5	10.75	8.50	147	Overcast
6/19	0:00	5.0	9.0	20		0	10.00	8.38	150	Clear
6/19	12:00	11.0	9.0	100	NW	5	10.50	8.50	145	Overcast
6/20	0:00	8.0	9.5	100	NW	5	10.00	8.38	145	Overcast
6/20	12:00	9.5	9.5	100	NW	5	10.00	8.00	140	Overcast
6/21	0:00	9.0	10.0	100	SE	5	10.25	8.00	140	Overcast
6/21	12:00	12.0	10.0	100	SE	5	9.75	7.88	140	Overcast
6/22	0:00	9.0	10.0	100		0	9.50	7.38	137	Overcast
6/22	12:00	12.0	10.0	100	SE	5	9.00	7.13	132	Overcast
6/23	0:00	9.0	9.0	100	SE	5	9.00	7.25	129	Overcast
6/23	12:00	10.0	10.0	100		0	8.25	7.00	128	Rain
6/24	0:00	9.0	9.0	100		0	8.50	7.00	128	Rain
6/24	12:00	11.0	10.0	100	NW	5	8.75	7.38	130	Overcast
6/25	0:00	10.0	10.0	100	NW	5	8.25	7.00	128	Overcast
6/25	12:00	11.0	10.0	100	NW	5	8.25	7.00	125	Overcast
6/26	0:00	9.0	10.0	100	NW	5	8.25	7.00	128	Rain
6/26	12:00	10.0	10.0	100	NW	5	8.75	7.25	130	Rain
6/27	0:00	10.0	10.5	100	NW	5	8.50	7.25	125	Overcast
6/27	12:00	9.0	10.0	100	NW	5	9.00	7.00	125	Rain

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Appendix C. (page 5 of 5)

Date[a]	Time	Air (°C)	Water (°C)	Cloud[b] Cover (%)	Wind[b] Dir	Vel.[b] (Mph)	Trap Revolutions (rpm) Small	Large	Stream Gauge (cm)	Comments
6/28	0:00	9.0	10.0	100	NW	5	8.50	7.00	125	Overcast
6/28	12:00	11.0	10.0	85	SE	5	8.50	7.13	120	Overcast
6/29	0:00	9.0	10.0	60		0	8.00	6.75	120	Partly Clear
6/29	12:00	15.0	10.5	25		0	8.00	7.00	120	Mostly Clear
6/30	0:00	9.5	11.0	60	NW	10	8.00	6.75	120	Partly Clear
6/30	12:00	12.0	11.0	60	NW	5	8.00	6.13	119	Partly Clear
7/1	0:00	10.0	10.5	60	NW	5	7.75	5.88	118	Mostly Overcast
7/1	12:00	10.5	10.5	100	NW	5	7.50	5.75	115	Overcast
7/2	0:00	10.0	10.0	100		0	7.25	5.75	115	Overcast
7/2	12:00	11.0	11.0	100	NW	5	7.50	6.13	113	Overcast
7/3	0:00	9.0	11.0	100		0	7.00	5.38	110	Overcast
7/3	12:00	12.0	11.0	100	NW	5	7.00	5.88	110	Overcast
7/4	0:00	10.5	11.5	100	NW	5	6.75	5.75	108	Overcast
7/4	12:00	10.5	12.0	55	NW	10	6.50	5.75	105	Partly Clear
7/5	0:00	10.0	12.0	75	NW	5	7.25	5.63	105	Overcast
7/5	12:00	10.5	11.5	100	NW	5	6.75	5.75	102	Overcast
7/6	0:00	11.0	11.0	100		0	6.75	5.75	105	Overcast
7/6	12:00	14.0	12.0	100		0	6.50	5.63	101	Overcast
7/7	0:00	9.0	11.0	100		0	6.25	5.63	101	Overcast
7/7	12:00	12.0	12.0	100		0	6.25	5.50	100	Overcast
7/8	0:00	10.0	11.5	100		0	6.00	5.50	100	Overcast
7/8	12:00	12.0	11.5	100	NW	5	5.75	5.50	100	Overcast
7/9	0:00	10.5	11.0	100		0	6.00	5.38	100	Overcast
7/9	12:00	14.0	11.0	100	SE	5	5.75	5.50	97	Overcast

[a] Actual calender dates.

[b] Based on observer estimates.

Appendix D. Distribution list.

Individual	Organization	Address	# of copies
Chuck McCallum	Chignik Regional Aquaculture Assn.	2731 Meridian #B Bellingham WA 98225	10
Hazel Nelson	Lake and Peninsula Borough	1577 C St. Suite 330 Anchorage AK 99501	1
Mark Witteveen	ADF&G	Kodiak ADF&G Office	1
Steve Honnold	ADF&G	Kodiak ADF&G Office	1
George Pappas	ADF&G	Kodiak ADF&G Office	1
Nick Sagalkin	ADF&G	Kodiak ADF&G Office	1
Kenneth Bouwens	ADF&G	Kodiak ADF&G Office	3
Jim McCullough	ADF&G	Kodiak ADF&G Office	1
Eric Newland	ADF&G	Kodiak ADF&G Office	1
Hector Bravo	ADF&G	Kodiak ADF&G Office	1
Drew Crawford	ADF&G	Anchorage ADF&G Office	1